SIX ELEMENT MATURITY MODEL FOR HEALTH AND SAFETY IMPROVED PERFORMANCE IN KUWAITI OIL SECTOR

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Certificate of Originality
I, Jefain Al-Hajri, do hereby declare that this piece of research has been conducted with the utmost due care and responsibility; and that the sources of the work have been duly acknowledged. Therefore I declare that this piece of work is solely mine and that it has not been plagiarised from any other sources.

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Abstract
The management of health and safety risks in the oil refinery tends to be centred on the collection and simulation of technical data which can then be used to make decisions on the wellbeing of the workforce as well as the refinery installations. While the number crunching in the process is immensely vital, there tends to be a problem of ignoring or, at the very least, side-lining the social-cultural values of the people dealing with health and safety risk assessment processes. The economic driver for the operation of the oil refinery tends to be more important because of the generally huge initial financial outlay, and the eventual high costs of maintenance; hence health and safety risk management should have evidence of ensuring that the installations, as well as the people that work in them, are well catered for. In the Kuwait Gulf Oil Company this problem is more evident in newer installations where lean management processes have been instituted by oil firms so that they can reduce waste in the oil refining process without compromising the occupational health and safety needs of the refinery. Therein lies the initial problem of integrating health and safety risk assessment processes because most approaches concentrate on the technical elements of waste elimination while ignoring the social-cultural factors that impact on the health and safety of the workforce.

This is an exploratory piece of research that examines the impact of rational and cognitive decision theories – herein called the psychology of risk – and how they impact on the occupational health and safety systems in the oil and gas refining sector of Kuwait. The research concludes that the application of lean concepts in the oil refining process is noble in itself but it needs to be integrated with the rational and cognitive detection factors that are necessary to incorporate and support the social-cultural tendencies of the workforce. The research recommends a framework for incorporating social-cultural values in the decision making process pertaining to health and safety risk assessment in oil refining process plants.

Key Words: occupational health and safety risk assessment; lean management; social-cultural values; rational and cognitive decision making; oil and gas process plants.
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List of Conference Publications


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1. **CHAPTER ONE: GENERAL INTRODUCTION AND THE BACKGROUND TO THE RESEARCH**

1.1 **Introduction**
The management of risks in the oil refinery tends to be centred on the collection and simulation of technical data which can then be used to make decisions on the wellbeing of the workforce as well as the refinery installations. While the number crunching in the process is immensely vital, there tends to be a problem of ignoring or, at the very least, side-lining the social-cultural values of the people dealing with risk management processes. At times when decision making is required, a number of concepts and models can be used. Ultimately, integrating the decision analysis processes becomes crucial for a proactive risk management strategy for any industry. For instance, decision analysis involves concepts borrowed from probability theory, statistics, psychology, finance and operations research (Schuyler, 2001); it means that there are elements of social-cultural understanding within the risk assessment processes. However, the many elements of decision analysis, if disintegrated, would yield a poor result for risk assessment. The PMI (2004) define integration management as the processes required to ensure that the various elements of the project are properly coordinated. The main aspect of project integration management is that project planning development, project plan execution and integrated change control (ibid) are used as early as possible for all aspects of a project. If applied to the management of risk or the assessment of risk, ‘integrated risk assessment has been defined as a process that combines risks from multiple sources, stressors and routes of exposure for humans, biota and ecological resources in one assessment (Assmuth and Hilden, 2008).

This research aims to evaluate the impact of social-cultural values on health and safety management in oil refineries in Kuwait, by assessing how the social-cultural and behavioural tendencies of the local workforce would impact on the health and safety risk performance of the industry for now and in the future when there would be less reliance on an expatriate workforce.
1.2 Research Background and the Research Problem

The management of health and safety risks in the oil refinery tends to be centred on the collection and simulation of technical data which can then be used to make decisions on the wellbeing of the workforce as well as the refinery installations (Assmuth and Hilden, 2008). While the number crunching in the process is immensely vital, there tends to be a problem of ignoring or, at the very least, side-lining the social-cultural values of the people dealing with health and safety risk assessment processes. For example, all the operational incidents that have taken place in Kuwaiti oil and gas have been researched at the technical level; however, the impacts of social, cultural and behavioural tendencies of the workforce have not been explored. As a result, operational as well as environmental problems have been top of the list in Kuwait, because accidents relating to the oil and gas processes have been observed over the years. For instance, KUNA (2011) was quoted by DailyMotion.com with regard to the four people who were killed due to an explosion. The Kuwait oil refinery blast took place on October 1, 2011. Four workers were killed and two others injured on Saturday in a gas blast at an oil refinery in Kuwait. According to the Kuwait National Petroleum Corporation, the explosion was caused by a gas leak during routine maintenance work. Fire engines and ambulances have rushed to the scene after the accident took place.

GulfBusiness.com (2012) validated the information when they reported that Kuwait Oil Company set fire to an oil well in the north of the OPEC member state on Wednesday to get rid of gas leaking from the site, state news agency KUNA said. The state-owned company said levels of the hydrogen sulphide gas from a well at the Rawdatain oil field close to the Iraqi border were “far below danger levels”, KUNA reported in a short messaging system (SMS) alert. In this example, we note that the decisions made to set the gas leak on fire could easily have been largely technically oriented; however, the choice of communication medium for reporting the impact of the decision was arrived at by management in a social-cultural manner because there was no particular justification for choosing the short messaging system (sms) to disseminate the information.

Like any other industry, operations of the oil refinery demand huge initial financial outlay, and the eventual high costs of maintenance. Therefore lean production is important because companies try to reduce costs while maximising profit (Bartlett, 2004). However lean the productivity in the oil and gas can be, operators have to deal with the occupational health and safety of the workforce should there be a disaster caused by choices that are made in the
production process (Grier and Sidnell, 2010). Therefore, risk assessment of the decisions driven by lean productivity becomes crucial and needs to be timely because too much of it would imply cost cutting measures (Aven, 2008) to increase profit while too little would be tantamount to being wasteful (Meiling et al., 2012). For instance, past experience shows that being too ‘lean’ could result in the materialisation of accidents such as the BP gulf of Mexico 2010 (BBC, 2011). The incident was not only a technical failure but also a public relations disaster, explained the BBC (2011) because the company had been involved in previous incidents that were linked to cost cutting measures.

Currently, there is a realisation that technical risk assessment is necessary in the oil and gas industry as it brings out necessary quantitative data that can be used to understand the performance of the systems (Aven and Vinnem, 2005; 2007). However, if the health and safety risks are to be properly managed, there should be a framework that can provide a mechanism that can ensure that installations, as well as the people that work in them, are well catered for as and when there is an introduction of lean production. We could argue that currently decisions that rely on cost saving measures tend to result in poor management of occupational health and safety (BBC, 2011), mainly because health and safety analysts have long been psychologically conditioned to rely heavily on technical data without due consideration for social and cultural bias in the process.

The main knowledge gap, therefore, has been in a lack of mechanisms that can incorporate social and cultural values within the health and safety risk assessment process, hence discounting an important component of risk assessment. With this in mind, it was vital to assess the impact of social-cultural values on health and safety management in oil refineries in Kuwait.

1.3 Rationale for the Research
The economic driver for the construction and operation of the oil refinery tends to be more important because of the generally huge initial financial outlay and the eventual high costs of maintenance; hence, risk assessment should have evidence of ensuring that the installations as well as the people that work in them are well catered for. In Kuwait Gulf Oil Company (KGOC), this problem is more evident in newer installations because of the strategic interest not only of the executives but also the government. Therefore the initial problem of integrating health and safety risk assessment with social-cultural and behavioural elements of
the workforce is non-existent. The social-cultural and behavioural tendencies of the workforce are rarely captured in the health and safety risk assessment, leading to the adoption of methods that are biased towards technical risk assessment.

Even though some of the risks are more pronounced than others, the oil and gas risks could not be managed without placing them within their cultural, sociological and psychological context (Hokstad and Steiro, 2006). This means that the review of policy with social-cultural and psychological perspectives is centred on the preparation for and understanding of human error when the works are being executed (Aven, 2008). Human error emanates from the issue of human factors as far as risk and health and safety are concerned (Sjoberg, 2001). In a wider sense, the term “human factors” refers to the behaviour of humans that can affect workplace risk, and it has the following characteristics (Targoutzidis, 2010):

- Intentional behaviour – which involves conscious risk-taking by means of deliberate acts not in accordance with the explicit safety rules;

- Unintentional behaviour – which involves erroneous acts that violate the explicit safety rules.

Both these kinds of behaviour can affect safety in the workplace and thus have to be incorporated in the assessment of risks in order to take situation-specific conditions into account (Targoutzidis, 2010).

Like any industry, safety of the workforce and the public is paramount. By industrial safety, we mean the control of persons, materials, machines and systems of work in order to provide and maintain a working environment in which people will not be injured, or suffer damage to their health, or in which property is damaged (HSE, 2005). This also means that the health and safety cannot be looked at as an isolated theme, rather as an integral part of the overall productions system of the industry and that integrating the management of health and safety risks would eventually benefit more elements of risk inherent in the industry. Hokstad and Steiro (2006) contended that the way to integrate the management of health and safety risks is to take a holistic approach. This would mean taking a unified and common strategy for assessing and handling risk, based on a ‘common language’ concerning integration.

This research, therefore, evaluates the impact of social-cultural values on health and safety management in oil refineries in Kuwait. It examines how social-cultural and behavioural
tendencies of the local workers impact on the health and safety risk performance of the oil refinery sector of Kuwait.

1.4 Aim and Objectives
The research focus is twofold: (i) evaluating the impact of social-cultural values on health and safety management in oil refineries in Kuwait and (ii) assessing the pressure that lean management exerts on technical risk assessment processes within the oil industry.

1.4.1 Explanation for the Aim
For a long time, Kuwait, like any other country in the Middle East and North African (MENA) region, has relied on technical manpower from the international community especially in the management of oil and gas facilities regarding risks, health and safety. However, there has been a constant pressure to replace international expatriates with local personnel. Technically, there is no problem with this approach, though there are management constraints in the maintenance of the levels of performance that have been seen from international personnel, mainly because the attitude towards work, risk, health and safety has been reinforced over the years by the social-cultural and behavioural tendencies that each worker brings to Kuwait and the region at large.

The inherent implication of the policy of replacing international personnel in the hydrocarbon industry of Kuwait is that the systems of managing the risks would have to: inevitably, take on the technical as well as a social-cultural dimension. The social-cultural dimension needs clear understanding and mapping into the system of things as they stand.

Another crucial issue for this research has been the influence of lean production on health and safety risk assessment decisions for the oil and gas industry in Kuwait. Industry trends (section 1.2) have indicated that there is a fine line between lean production and cost cutting measures that could induce risk taking amongst decision makers. It is therefore crucial to assess the psychological conditioning that decision makers adopt within the industry so as to examine the road map for the management of health and safety risks while promoting lean thinking in the industry.
To achieve the aim of the research the following objectives have been developed:

i. To evaluate how the psychology of risk is taken into consideration within oil refineries’ work environments in Kuwait

ii. To analyse the pressure that lean management wields on technical risk assessment processes within the oil industry

iii. To assess the overall technical approach to integrated health and safety risk assessment in the oil refining process in Kuwait, at all levels of management (strategic level to shop-floor level)

iv. To assess the impact of the social-cultural environment on the technical application of risk assessment

v. To recommend a framework for integrating attributes of the psychology of risk in the day to day operations of the oil refinery

1.5 Hypotheses

(i) Hypothesis 1: The social-cultural perceptions of hazards do not influence the current health and safety risk assessment techniques in oil refineries
   a. Dependent variable: current risk assessment techniques
   b. Independent variable: social-cultural perceptions of hazards
   c. Group: oil refinery workforce in Kuwait

(ii) Hypothesis 2: Applying lean management in oil refineries with a diverse workforce that uses a second language weakens risk assessment processes
   a. Dependent variable: robustness of the risk assessment processes
   b. Independent variable: application of lean management
   c. Group: oil refinery workforce of Kuwait

(iii) Hypothesis 3: Undertaking risk assessment in oil refineries where a diverse workforce uses a second language reduces the instances of incorporating the psychology of risk
a. Dependent variable: instances of incorporating the psychology of risk  

b. Independent variable: Undertaking risk assessment  

c. Group: oil refinery workforce of Kuwait

(iv) Hypothesis 4: The future safety practice in oil and gas refineries can be robust if there is unification of diverse opinions about risk assessment  

a. Dependent variable: robustness of the future safety practice  

b. Independent variable: unification of diverse opinions about risk assessment  

c. Group: oil refinery workforce of Kuwait

1.6 Proposed Methodology

Theoretically, the choice of research strategy depends on many factors, but the key ones according to Naoum (2007) are related but not limited to: (i) the type of the research; (ii) the availability of the information required to carry-out successful research. Flick (1998) further reasoned that an ideal research methodology at a particular point in time should be viewed through its appropriateness. Because research evaluates the impact of social-cultural values on health and safety management in oil refineries in Kuwait, it was crucial that the choice of research methodology as well as the data collection tool complemented each other. For this reason, a qualitative research methodology was adopted. Naoum (2007) stated that “qualitative research is subjective in nature and that it emphasises meanings; experiences and descriptions”. This research method uses two strategies:

1. Exploratory: used when you have a limited amount of knowledge about a topic. Research can explore the topic with a combination of various methods such as interviews, observations, and the like, to make sure the information makes sense (Naoum, 2007; Dawson, 2002).

2. Attitudinal: a subjective way of evaluating the opinion or view of a person about a topic (Dawson, 2002).

The qualitative approach can be said to rely very heavily on the attitude of the researcher and the measurement is based on opinions, views and perceptions (Naoum, 2007). There is a need for a researcher to get ‘rich and deep’ data to make such a research method effective and in
order to allow this to happen, it was important to generate a set of questions that were used in an interview-based survey with the employees of the KPC that were naturally stratified by their role in the corporation.

Not all respondents could be interviewed, therefore a questionnaire survey was also considered as an essential element in the data collection on technical risk assessment in the oil refineries in Kuwait.

In addition, a case study based on the existing risk assessment strategies for the refinery, including the collection of data on the performance of various components used for modelling risk was considered an essential element of the research data collection.

1.7 Scope of the Research
i. For this research to be properly carried out there was a need to study social –cultural studies, including human-related studies for the hydrocarbon industry.
ii. Then there was a need to review the current technical risk assessment strategies applicable to the hydrocarbon industries.
iii. There was an additional need to evaluate the possible link, and ultimate impact that social-cultural factors would have on overall risk assessment in refineries.

1.8 Detailed Conceptual Framework for the Research
Figure 1-1 illustrates the detailed conceptual framework for this research by highlighting a 3 tiered approach to the implementation of the research process. The first tier covers (i) the problem relating to the psychology of risk; (ii) the lean management processes within the industry and the uncertainty associated with the oil and gas business environment; (iii) the health and safety risks as applied in the process of technical risk assessment that typify the oil and gas industry in any country. Tier 2 sets out the platform for primary data collection. Tier 3 is envisaged to comprise the contribution of the research to knowledge within the risk assessment systems of the industry.
Psychology of Risk and the Decision Making Process

Business Operations in an “Uncertain and Complex Environment” (A)

Lean Concept (Reduce Waste Maximise Profit) (B)

(A+B) Trigger Technical and Non-Technical Risk Assessment Processes

Valid Tools and Techniques for Risk Assessment

No Clear Tools to account for “Human Psychology”

Cultural Attributes being a factor

Social and Religious Profiling

Holistic Risk Assessment?

Industry Standards and Norms

Tier One

Literature on Risk, Lean and the Business Environment for the Oil and Gas Industry

Tier Two

Patchy information in application of risk assessment in the four categories

Tier Three

PhD Research to Contribute Knowledge

Figure 1-1: Conceptual framework for the research comprising a 3-tier process to understanding the research cycle
1.9 Breakdown of the Chapters in the Dissertation

Chapter one: Introduction

The introductory chapter explains the research background as well as the problem of social-cultural tendencies of risk assessors in the oil and gas industry in Kuwait. The chapter explains the rationale for the research, aims and objectives as well as the proposed research methodology. Therefore, chapter one acts as a precursor to the whole research problem and the reasoning behind the research so as to set the scene for the reader to familiarise themselves with the situation that ultimately triggered the research. This chapter also presents the approach to the research, with a deductive style questioning why the hypotheses have been arrived at, and showing that the aim and objectives have guided the overall approach to the research, including the structure of the dissertation and the way the information has been presented in the literature review chapters that follow chapter one.

Chapter Two: Literature Review of Psychology of Risk

The literature on psychology of risks explores the decision making processes that people undergo when they are faced with situations that demand action. Due to the psychological conditioning that people undergo through training, it is common to find that decision makers use biased judgement when they are undertaking risk assessments. The idea of the literature review on psychology in general, and how it affects decision makers, is to try and explore how company decision makers are included in making decisions without necessarily evaluating them with regard to the merit of their decisions. Many sources of literature on risk assessment leave out the drivers to decision making because there is a general approach which is biased towards number crunching over any issue related to risk assessment. However, decisions have to be made and decision makers are bound to be influenced by the psychological conditioning that is naturally present in many work places. This literature review chapter therefore explores the bias associated with humans and how personality can influence decision making due to peoples’ beliefs and human behaviour. The chapter argues that not all decisions are well thought out because decision makers are not always rational because they are bound by many factors such as personality, beliefs and culture.
Chapter Three: Literature Review on Lean Management and its Influence on Occupational Health and Safety Risks

When an organisation wishes to shade some excess waste and improve the levels of productivity by ensuring that they can focus on the customer needs and that non-value adding activities are shaved off, they apply a myriad of techniques amongst which is lean management. The Toyota Production System (TPS) is known to have applied lean management by ensuring that the automobile manufacturer was able to identify waste and to institute value adding processes hence making the process of manufacturing Toyota cars an efficient regime. The whole world has taken after the TPS model, including the oil and gas industry. This is because waste is counterproductive in any business. However, there have been incidents in the oil and gas industry where companies were cost cutting in the name of applying lean management. They ended up destroying the very fabric of production. Therefore, it is important to use this chapter as a literature review to examine the pressure of making the production process lean, and how the standard procedures for assessing health and safety risks can be inadequate for handling the factors that are triggered by the unconditional responses that workers have to their social and cultural wellbeing. This chapter also explains that while lean productivity is essential, it has been misapplied in the production process as a cost cutting tool, hence triggering safety concerns in the oil and gas industry. The literature basically links poor application of lean management and the consequent threat to oil and gas refinery plants around the world.

Chapter Four: A Synthesis of Risk Management in Oil Refineries and the Impact on Occupational Health and Safety

This chapter is also a literature review chapter which provides a synthesis of risk management in oil refineries and the impact on occupational health and safety. Basically, as the critical discussion of the research tackles many elements of the subject matter, it is possible that the argument could appear fragmented at times. In order to bring coherence and harmony to the research, it is important to add a literature review chapter the aim of which is to synthesise the critical writing and clearly point the reader to the main focus of the research which, in this case, is health and safety in the work place. Therefore, chapter four offers a chance for the reader to integrate all the current strategic and operational responses to health
and safety risks so as to ensure that the information in chapters 2 and 3 can be applied to real
life incidents within the oil and gas sector around the world. A synthesis chapter in this
dissertation acts as a bridge to the separate literature topics covered in chapters 2 and 3,
thereby allowing the research to consolidate valid theoretical applications to the research
problem.

Chapter Five: Research Paradigm, Methodology and Methods

This chapter is a research based literature review and a critical analysis of how best to design
the research process based on the approved research paradigm, methodology and methods. In
any research project it is important to establish the ideal process for which the research is to
be undertaken by critically examining the philosophical stance that is to be undertaken, as
well as establishing the rationale for the choices made with regards to the research
methodology and data collection methods. This chapter, therefore, explores the strategies for
research in general, including the justification for the chosen strategy and method of data
collection. It also explains the method of data analysis as well as the ideal sample that was
decided upon for the research. The chapter also summarises the main themes of the research
using diagrammatic representation of the theoretical framework and how it has been used in
the data collection based on a questionnaire survey.

Chapter Six: Data Collection and Analysis of Results

This is primarily a data collection and analysis chapter which presents the results of all the
primary data. In order to make the work more structured, it was important for chapter six to
address the issue regarding the way information was gathered from the questionnaire survey
and from the validation exercise conducted with selected respondents to discuss the
implications of the results. After collecting the data it was vital to assess the meaning behind
the information by circulating the results within the Middle East and North African (MENA)
region. However, due to the high security demands for oil and gas installations around the
MENA region the response for the validation exercise was not as good as was anticipated.
This is the chapter which also links the theories that are propounded in the literature review
with the primary information by comparing the theory with the practical information that was
collected from the industry. Therefore, chapter six paves the way for further analysis of the information in chapter seven.

Chapter Seven: Presentation and Analysis of Results from 2 Case Studies

This chapter contains a presentation and analysis of results from two case studies that were adequately covered by the research process. Two case studies were found to be useful in order to examine the current events relevant to health and safety risks in the oil and gas industry within the workplace where the research was conducted and within Kuwait. The results from the case studies were useful in validating the results for the research. If the information presented in Chapter 6 was not tested in a case study situation there is a good chance that there would have been a gap in the appreciation of the health and safety situation regarding cost cutting and lean application in oil refineries; therefore, it was important that case studies were found so as to test if the theories emanating from the primary information in chapter 6 could be validated.

Chapter Eight: Discussion of the Development of a Framework for a Social-Cultural Integrated Risk Assessment Model

This chapter comprises the discussion and framework development section of the dissertation because it takes the elements of social-cultural factors found in integrated risk assessment and lean productivity in order to make a schematic model to present the results of the research. Having collected all the information from the literature review, the questionnaire survey and the case study, it was imperative that a model be developed so that the research can have a tangible end result. Under this section the research hypotheses have been tested and results presented so as to be used in the development of a schematic presentation of the proposed framework that could use social, cultural and psychological factors to positively affect health and safety risks assessments in the work environment.

Chapter Nine: Conclusions and Recommendations

This is the final chapter which concentrates on the explanation of the general conclusions and recommendations from the research. These have been presented in this section because they are meant to explain the overview of the research and the recommendations that could make a difference in upholding the health and safety of the workforce in the oil and gas industry in
Kuwait and the MENA region at large. Clarity is a crucial element in this chapter because the results of the research can be used not only in the MENA region but anywhere in the world because decision making affects everyone.
2. CHAPTER TWO: REVIEW OF PSYCHOLOGY OF RISK

2.1 Introduction
It is natural to assume that decision makers entrusted to perform technical tasks use rational processing in their line of work. According to Jarcho et al. (2011, p460) “decision-making is a ubiquitous part of daily life and people often make difficult choices between equally attractive alternatives”. By definition, decision making is the “process of making choices from a number of alternatives” at any given point in time (Buchanan and Huczynski, 2010, p630). Decisions have to be made concerning the operation of the business – hence the consequences of the decision could be positive, negative and or neutral. This means that at any level of the organisation, decisions form part of the core management function of any operation because they represent the “art of getting things done” (ibid). However, regardless of the level of decision making, there tends to be individual, organisational and or group influence on the decision making process. Depending on the operations under consideration, personal influence in the decision making process is a function of many factors such as the level of general knowledge one has, the cognitive influences that decision makers are exposed to (Batey et al., 2010), as well as the social-cultural biases that emanate from a decision maker’s life experience. It can therefore be argued that personality and the experiences that a decision maker has had could significantly impact on their perception of issues related to the operations about which they are entrusted to make decisions. In the case of the psychology of risk, it is important to evaluate the models of decision making in terms of their impact on the social-cultural factors that are inherent in the oil and gas industry in Kuwait and the Middle East in general.

2.2 Classical Decision Theory Models in General
The traditional approach to understanding individual decision making is based upon the classical decision theory coupled with the rational economic model - originally developed in economics, whereby there is an assumption about how people think and how they make decisions (Buchanan and Huczynski, 2010, p630). Figure 2-1 abstracts the rational economic model of decision making which relies on the theory “that decision makers are objective, have complete information and consider all alternatives and their consequences before selecting the optimal solution” (Buchanan and Huczynski, 2010, p631). In addition, the
theory assumes that the decision maker is a rational person who undertakes a rational “process consisting of a sequence of steps that enhance the probability of attaining a desired outcome” (Buchanan and Huczynski, 2010, p631) (Figure 2-1).

![Diagram of the rational economic model of decision making](image)

**Figure 2-1:** The rational economic model of decision making (Source: Buchanan and Huczynski, 2010, p631)

Using the information presented in Figure 2-1, it is possible to examine the rational decision-making process and compare it with bounded rationality. From the comparison, it is vital to explore the role of personality and human behaviour as a contributory factor in decision making.
2.2.1 Rational Decision Makers Compared with Bounded Rationality Decision Makers

The application of “rationality” in decision making basically means that a decision maker has taken a scientific process of reasoning, coupled with empiricism and positivism, and with the use of decision criteria of evidence, logical argument and reasoning” (Buchanan and Huczynski, 2010, p631).

However, Buchanan and Huczynski (2010, p631) believe that the reality is far more difficult for a decision maker for the following reasons:

(i) It is rarely possible for one to consider all alternatives especially if there are too many, and some alternatives will not have occurred to the decision maker;
(ii) It is impractical to consider all consequences and it is not possible to evaluate the estimate of the consequences because the estimation process can be complex, time consuming and costly;
(iii) The available information is rarely accurate and often outdated – making it only partially relevant to the issue to be solved. Additionally, information costs money to generate or purchase hence decisions are made on incomplete, insufficient and only partly accurate information;
(iv) Decision makers, as individuals, lack the mental capacity to store and process all the information relevant to a decision, hence, they frequently lack the mental ability to perform the mental calculations required.

2.2.2 Bounded Rationality Decision Making

Yao and Li (2013, p19) explained that human rational behaviour “is shaped by a scissors whose two blades are the structure of task environments and the computational capabilities of the actor”; they used this analogy to “characterise bounded rationality as a mechanism through which those psychological features are shaped to cope with incomplete information, which arises from the gap between the complexity of the environment where people operate and their limited mental abilities”. The rational behaviour of decision makers is evidenced by their biases such as “preference bias (loss aversion), belief bias (optimism or pessimism)”, to mention but two. When you add the factor of incomplete information (parameter uncertainty) coupled with trait of loss aversion and optimism (pessimism) in terms of value maximisation, it is possible that decision makers are bounded in their rationalisation process (Yao and Li, 2013, p19). Nelson (2008, p78) used the term “bounded rationality” to “connote the
reasoning capabilities of an actor who, on the one hand, has a goal to achieve and an at least partially formed theory as to how to achieve it, and on the other hand, that the theory is somewhat crude, likely will be revised in the course of the effort, and that success is far from assured”. Bounded rationality, therefore, is a human and organisational problem solving theory that sees people as actors who are guided by a cognitive map – or some “good old fashioned artificial intelligence” (Nelson, 2008, p78). This implies that human behaviour is as important to the decision making process as is organisational behaviour, hence “the presumption that human problem solving proceeds under the guidance of cognitive maps” (ibid).

According to Koumakhov (2009, p294) people do not just develop cognitive maps in isolation. They tend to capture social-cultural values and behavioural codes of their generation which they can subconsciously use in their decision making because these values are cardinal to their perception of the world. Koumakhov (2009, p297) further explained that “the intended rationality of an actor requires him to construct a simplified model of a real-life situation in order to deal with it. He behaves rationally with respect to this model, and such behavior is not even approximately optimal with respect to the real world”.

We can therefore conclude that there are two dichotomous forces working within the bounded rationality theory. The first force leads with a belief that “human behavior, whether in isolation or embedded in social situations, can be explained, with proper modifications if necessary, within the rational choice framework where preferences are treated as given data” while the second force maintains that “social norms and order shape preferences of individuals and give meaning to their actions” (Hayakawa, 2000, p1). As a result, professions have recognised four main sub-arguments with the bounded rationality theory (Hayakawa, 2000, p2): (i) “the decision-making environment including the internal psychology and the cognitive capacity of a decision maker may be significantly short of being perfect; (ii) because the time endowment is fixed, every activity including cognition competes for the use of time; (iii) information on which decisions are based is almost always incomplete, but information gathering and processing is costly; and (iv) many decision making situations are imbued with elements of risk and uncertainty”. Therefore any decision maker can either take the form of rational approach or the bounded rationality approach – as summarised in Figure 2-2.
If the decision maker decides to take the route of “bounded rationality”, this implies that making a decision is to be done by constructing simplified models that extract the essential features from problems without capturing all their complexity” (Buchanan and Huczynski, 2010, p633); however, taking either approach, in reality, means facing challenges as explored in the next section.
2.3 Descriptive Decision Making Models and their Application to Risk Assessment

The use of bounded rationality does not only rely on positivism but also the use of descriptive decision making models. The descriptive models of decision making are based on investigating how individuals actually make decisions; this could relate to decisions made on their own or when they are in a group or when they are in a powerful position (Buchanan and Huczynski, 2010, p632). For instance, Hayakawa (2000, p2) argued that whenever a decision maker experiences serious limitations they can be motivated “not only to choice objects but also to how to handle the limitations without sacrificing too much of his resources”. This basically means that the decision maker strives to save cognitive efforts, and to absorb bounded rationality in general becomes a matter of no trivial importance” because the procedural rationality is important to the understanding of human behaviour (Hayakawa, 2000, p2). Therefore, descriptive decision making models are largely centred on human behaviour, the personality of decision makers and their level of creativity, intention and attitude at the time of the decision making. This may also mean that the decision is impacted upon by the decision makers’ attitude, personality, creativity and general behaviour. When the decision maker uses “intentional” rationality, they tend to apply the “uncertainty reduction processes such as (i) tradition, habit, and routines; (ii) norms and institutions; (iii) structural predispositions of decisions such as social networks, organizational structures and past decisions and (iv) power relations (Hayakawa, 2000, p4).

From the descriptive decision making model, Bratton et al. (2007, p348) believe that the rational model is but a rhetoric used by managers at the very top of an organisation’s bureaucracy, and it reinforces managers’ claim to knowledge and competence. However, this normative model of decision making is rarely realised fully or extensively in practice. However, at the individual level, rationality is constrained by at least four factors: information processing failure, perceptual biases, intuition and emotion and escalation of commitment as examined below.

2.3.1 Information Processing Failure

Bratton et al. (2007, p348) explained that individual managers do not make wholly rational decisions because they may not acquire sufficient information to make a perfect decision, or they have too much information, and this prevents them from making a good decision. Therefore, individuals make bad or non-rational decisions because of incomplete information; Herbert Simon called this “bounded rationality”. He defined it as the processing
of limited and imperfect information and satisfying rather than maximising when choosing among alternatives (Bratton et al., 2007, p348). The bounds of rationality often force managers to make decisions based on intuition or what is commonly called the “gut feeling”. Intuition is defined as the ability to know when a problem or opportunity exists and select the best course of action without conscious reasoning. While intuitive decisions may be seen as non-rational because they do not follow the model, it can be argued that hunches or guesses can be an effective way to make decisions since the subconscious brain may provide the conscious brain with information (ibid).

While incomplete or imperfect information can be a barrier to rational decision making, too much information can also prevent optimal decisions. Information overload is the reception of more information than is necessary to make effective decisions. It may be caused by the quantity of the information to be processed, the speed with which the information presents itself, and the complexity of the information to be processed. Rather than improving decision making, information overload can lead to errors, omissions, delays and corner cutting (Bratton et al., 2007, p349).

Therefore, it has been observed that managers choose the first alternative that does the job, or meets the requirements of the problem to a satisfactory degree, rather than the best alternative; hence, they select an alternative that is satisfactory rather than optimal. Satisfying occurs because of information overload (Bratton et al., 2007, p349).

### 2.3.2 Perceptual Biases

By definition, “perception is the process of selecting, organising and interpreting information in order to make sense of the world around us” (Bratton et al., 2007, p189); therefore, “perceptual bias is the automatic tendency to attend to certain cues that do not necessarily support good judgements” (ibid, 196). The primary effect is a perceptual error in which we quickly form an opinion of people based on the first information we receive about them” (ibid). Bratton et al. (2007, p349) explained that along with processing information and evaluating quantitative and qualitative considerations, individuals make imperfect decisions because of flawed perceptions; selective interest mechanisms cause relevant information to be unconsciously filtered out. Moreover, managers, workers and other with vested interests try to influence people’s perceptions so that it is more or less likely that a situation is perceived as an opportunity or challenge, see Table 1. Another perceptual problem is that
people see opportunities or challenges through their mental models. These working models of reality help individuals make sense of the world, but they also perpetuate assumptions that obscure new realities (Bratton et al., 2007, p349).

Table 2-1: Explanation for perceptual bias by decision makers (Bratton et al., 2007, p350)

<table>
<thead>
<tr>
<th>Perceptual bias</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of recall</td>
<td>Individuals judge events that are more easily recalled from memory to be more numerous than events of equal frequency whose instances are less easily recalled</td>
</tr>
<tr>
<td>Insensitivity to sample size</td>
<td>Individuals frequently fail to appreciate the role of sample size in evaluating the accuracy of sample information</td>
</tr>
<tr>
<td>Over-confidence</td>
<td>Individuals tend to be over confident about the accuracy of their judgement when they answer moderately to extremely difficult questions</td>
</tr>
<tr>
<td>Method of memory search</td>
<td>Individuals are biased in their assessment of the frequency of events based upon the way their memory structure affects the search process</td>
</tr>
<tr>
<td>Illusory correlation</td>
<td>Individuals tend to overestimate the probability of two events co-occurring when their memory recalls finds that the two events have occurred together in the past</td>
</tr>
<tr>
<td>Hindsight</td>
<td>After finding out whether or not an event occurred, individuals tend to overestimate the degree to which they would have predicted the event without the benefit of hindsight</td>
</tr>
<tr>
<td>Regression to the mean</td>
<td>Individuals fail to note the statistical fact that extreme events tend to regress to the mean on subsequent trials</td>
</tr>
</tbody>
</table>

For example, people judge actions that are more vivid in their memory, they fail to pay sufficient attention to the skewed effects of sample size when evaluating the importance of data, and they tend to be overconfident about the accuracy of their judgement when addressing moderately to extremely difficult problems (Bratton et al., 2007, p349).

2.3.3 Intuition and Emotion
Bratton et al. (2007, p350) further argued that individuals in the work place can make decisions based on their intuition. Intuitive decisions may be seen as non-rational because
they do not follow the rational model, but research evidence suggests that intuition can play a role in strategic decision making. More than 80% of the organisational knowledge – information that has been edited, put in context and analysed in a way that makes it meaningful to decision makers – is implicit and is difficult to quantify or even describe accurately. It is suggested that intuition is the channel through which individuals use their implicit and tacit knowledge. Tacit knowledge is the wisdom learned from life experience, observation and insight which is not clearly understood and is therefore impossible to transfer to others (Bratton et al., 2007, p350).

The neoclassical rational model neglects to factor into the process the effects of emotions on individual decision making. While we know the rational dimension of the brain processes information about the various alternatives (imperfectly, because of cognitive capacity and time limits), the emotional dimension more rapidly creates emotional markers that attract individuals to some alternatives and cause them to be repelled by others (ibid). For example, people’s general disposition or mood can support or obstruct the decision making processes. Individuals tend to evaluate alternatives more accurately when in a negative or neutral mood, whereas they tend to engage in more perceptual biases when they are in a positive mood. This suggests that we need to be aware that decision making and logical analysis are affected by human emotion.

The rational model disregards the effects of gender on the decision making process, which suggests that its underlying characteristic is a make-related phenomenon and is not applicable to all employees. Social factors, such as how collective social norms and expectations frame ‘sense-making’ or problem definition, tend to be neglected in orthodox treatment of decision making (Bratton et al., 2007, p351).

### 2.3.4 Escalation of Commitment

According to Bratton et al. (2007, p189) escalation of commitment is the tendency to allocate more resources to a failing course of action or to repeat an apparently bad decision.

Ultimately, the decision maker receives stimuli from the external environment and the internal environment alike, as shown in Figure 2-3. Immediately the decision maker receives the information, he/she has to interpret it in a particular way, and that interpretation may be influenced by his/her social, cultural, and political biases. Factors such as his/her goals,
expectations, motivations, experience, habits and the like have a role to play as well (Bratton et al., 2007, p192). However decision makers have to filter the information and select that which they feel is of value as an input in the decision making process. When the decision is interpreted, they can decide and so the issue of feelings, attitudes and behaviour is intertwined within the decision making environment and, as such, it would have an influence on the performance of the individual.
2.4 Influence of Cognitive and Perceptual Factors on Decision Makers

Jarvstad et al. (2012, p591) asked the basic question: “whether people’s choices relate to efficiency functions in any meaningful way”. They explored the decision-making performance in the context of a low-level visual task: motion discrimination, during which they incrementally made the motion movement tasks more complex. They assessed the coherence of the decision-making in terms of judgement for efficiency and timing. The experiment was based on the presumption that “if people’s behaviour is well described by the optimal model, one would expect them to be sensitive to such manipulations” and that “if people’s behaviour is well described by the optimal model, one would expect people’s timing
choices to be near the optimal ones” (p589). They “compared timing decisions for a perceptual task with timing decisions for more cognitive tasks. Performance was highly similar across the tasks, which suggests that knowledge can be acquired, and used to make timing decisions, in an equally efficient way regardless of whether that knowledge is derived through perceptual or cognitive experience” (ibid, p589).

Buchanan and Huczynski (2010, p637) explained that within the cognitive reality of decision making, people tend to rely on heuristics which they defined as “a simple and approximate rule, guiding procedure, shortcut or strategy that is used to solve a problem”, and that bias – defined as “a prejudice predisposition or a systematic distortion caused by the application of a heuristic” – is a definite occurrence.

2.4.1 Decision Making under Cognitive and Perceptual Factors
Regardless of the type of environment, decision-making involves choice, and choice requires both careful thought and much information (Buchanan and Huczynski, 2010, p637), and that excessive information can both overload and delay people; hence, many managers believe that making the right decision late is the same as making the wrong decision. Therefore, they speed up the process by relying on judgement shortcuts called heuristics. Heuristic based decision-making, although faster and simpler, exposes its users to biases which are inherent in human intuition. Biases operate at the subconscious level, are virtually undetected, and have a powerful and immediate impact on individuals’ judgement (Buchanan and Huczynski, 2010, p637).

In line with Buchanan and Huczynski (2010), Ahmed et al. (2012, p20) explained that the process of decision-making is a crucial managerial function that is not getting any easier in many industries because of the complexity of the technology and political-social-economic factors on the one hand and the dynamic and uncertain environment on the other. In such a working environment, effective decision-making concerning “new business opportunities, products, customers, suppliers, markets and technical developments” is inevitable (Ahmed et al., 2012, p20). For risk managers, the decision-making goes beyond the strategic issues of production, markets and the like (Wood et al., 2012) because they need to capture the
perception of risk by those analysing it by using both risk assessment templates as well as cognitive mapping tools.

According to Ahmed et al. (2012, p21) a decision can be defined as the “answer to some problem or a choice between two or more alternatives”. It is a cognitive process with five key steps, namely: (i) stimuli; (ii) response; (iii) reflection; (iv) implementation and (v) evaluation. Ahmed et al. (2012, p21) further explained that if decision-making is taken as a process, it tends to have five steps, namely: (i) identifying all alternatives; (ii) valuing the alternatives according to preferences and potential outcomes; (iii) assembling the information; (iv) choosing between preferences and outcomes and (v) selecting the most favourable alternative. In the process of making decisions, it is common for people to develop habitual tendencies where their personal characteristics permeate their decisions in everything due to their personality, their level of ability and or their perception of utility in the decisions they make.

2.5 Role of Personality Types and Cognitive Style in Determining the Decision-Making Process

Even though the individual decision makers are likely to apply bounded rationality, they are expected to be creative as they deal with day to day problems of their work. In this regard, creativity is considered a process “involving the use of skill and the imagination to produce something new or a work of art” (Oxford University Press, 2011). Batey et al. (2010, p532) define creativity in relation to the concepts of novelty and utility. Hughes et al. (2012) opined that creativity is a very important component of human behaviour which is defined as the process and abilities that facilitate the generation of new, imaginative, useful and valuable ideas and products. Whether a person is creative or not it is believed that people are self-aware of their performance because they constantly evaluate their decisions, knowingly or unknowingly (Furham et al. 2011). Self-assessments of our abilities influence what we attempt to do and how much effort we expend, often serving as self-fulfilling prophecies. Thus, what one believes one is capable of doing is directly linked to what one will do and, resultantly, what one can achieve (Hughes et al., 2012).
2.5.1 Personality and the Influence on Decision Making

Hughes et al. (2012, p562-63) subdivide personality into five major categories:

(i) Neuroticism – this is defined as “a measure of affect and emotional control, with low levels suggesting good control over emotions and stability, whereas individuals with high levels may be somewhat sensitive and nervous with a propensity to worry. Neurotic means “not behaving in a reasonable, calm way, because you are worried about something” (Oxford University Press, 2011).

(ii) Extraversion – this implies that someone is “adventurous, sociable and talkative, whereas introverts are typically quiet and shy”. Depending on the personality of the person, an individual can easily participate in the risk assessment process or literally observe the process;

(iii) Openness-to-experience – where “individuals who demonstrate high openness-to-experience (openness) have broad interests and seek novelty, with low ratings linked to preferring familiarity and convention;

(iv) Agreeableness – where agreeableness is seen as a measure of how friendly people are, with high ratings being associated with individuals who are kind, sympathetic and warm;

(v) Conscientiousness – this refers to a person’s work ethic, orderliness and thoroughness. It has been suggested that Conscientious individuals are inclined to promote procrastination which serves as a distraction from more important tasks.

The personality traits are crucial for the decision-making process because they have an influence on the behavioural pattern of individuals entrusted to decide (Furnham et al., 2008, p1061). This means that the interactions between the components of individuals’ personality and the work environment can impact on the creative performance of the individual because cognitive ability is a function of personality.

Wood et al. (2012, p1333) believe that risk managers are increasingly interested in incorporating stakeholder beliefs and other human factors into the planning process. They argue that “effective risk assessment and management requires understanding perceptions and beliefs of involved stakeholders, and how these beliefs give rise to actions that influence risk management decisions. According to Ahmed et al. (2012, p22) “personality is often considered as a potential determinant of preferences for decision making”. There is a belief
that how an individual behaves can affect the way one thinks, perceives and evaluates one’s world.

Even though decision-making theories tend to categorise the models into “bounded rationality and rationality” the actual decision maker has personal control over what they do in order to arrive at a decision. Their choice is largely dependent on their personalised approach – herein called the cognitive style – whereby they process the information as they find it useful. For instance, one can choose “to think quickly and methodically, whereas, others prefer to analyse and reflect; on the other hand, some people like to act upon their thoughts rather than contemplating their actions. Thus, in the process of decision making, information is structurally managed by an organization through the human manipulation” (Ahmed et al., 2012, p22).

Human manipulation is not only a product of the choices one makes but it equally involves a decision maker’s ability to decide and his/her level of initiative and creativity; these are influenced by personal experience, training and learning styles (Ahmed et al., 2012). This implies that even if the process can be established, the decision makers’ ability or lack of can impact on the outcome of their decisions. In the risk assessment process, there are established technical procedures and processes that have been used by the industry over the years (Wood et al., 2012); however, such standard procedures do not prevent incidents from happening. Presumably, one of the key factors is the cognitive styles of thinking and decision-making which are inherent in individuals whose attributes can be evident in the way they seek, organise, process and evaluate information (Ahmed et al., 2012, p22). There is nothing wrong with the standard approaches to risk assessment in that they tend to standardise the approaches to information gathering. Wood et al. (2012, p133) believe that “formal analyses of risk manager and stakeholder cognitions represent an important first step”; other more important steps, such as the analysis of personalities and human behaviour, need to form an integral part of the next phase of risk assessment. Therefore, we can argue that this approach is premised on the belief that humans come to the work place with a varied approach to solving problems and that their decision making could equally result in a varied approach; but if a standard method is deployed there is a high likelihood that common solutions could be found. The standard approaches to risk assessment, however, do not deal with individuals’
belief systems, and people make decisions based on their conscious or unconscious application of the decision making process (Ahmed et al., 2012, p22).

2.5.2 Critique of Traditional Models of Decision Making
Much as the traditional models of decision making have made a significant impact on the analysis of the personality of decision makers, they have been found to have inherent weakness that inhibits their application to dynamic work environments. Take, for example, the issue of rationality – Jarcho et al. (2011, p460) believe that it is normal for people to rationalise their choices each time they are confronted with difficult decisions and that they do so by “claiming they never wanted the option they did not choose”. Once they decide, their behaviour and attitude inclines with their decision. “After a choice is made between initially matched options, people no longer find the alternatives similarly desirable” (Jarcho et al., 2011, p460). However, when the consequences of their decision are analysed, there is the possibility of attitudinal change.

Jarcho et al. (2011, p460) discovered that “people adjust their attitudes to support their decision by increasing their preference for the selected option, decreasing their preference for the rejected option or both. This rationalization is thought to be motivated by the drive to reduce ‘cognitive dissonance’, an aversive psychological state aroused when there is a discrepancy between actions and attitudes”. They further argued that “in situations when decisions cannot be reversed, or when doing so requires great effort, this discrepancy is often reduced by adjusting attitudes to be in line with decisions”. Such attitude change associated with difficult decisions is known as post-decisional attitude change. Therefore, there is a belief that “attitude change is driven by relatively slow, reflective cognitive processes, engaged well after decisions have been made, during post-decision attitude assessment, which typically occurs many minutes after decision making has taken place” (Jarcho et al., 2011, p460). It is expected, therefore, that a decision maker is likely to back his/her decisions even though the evidence presented by the consequences may indicate that another course of action would have been preferable; this can create a conflict in terms of a decision maker’s attitude towards the decision made (Parayitam and Dooley, 2011).

The other key anomaly with the traditional models of decision making is that they tend to explain the generics of cognitive abilities and decision making, but they ignore the pertinence associated with cognitive competencies attributable to the decision maker (Del-Missier et al.,
General cognitive abilities (fluid intelligence and numeracy) with different aspects of decision-making competence” could be controlled using executive functions – which are defined as “control processes involved in the regulation of cognition (ibid). To deal with such executive functions one might have to adopt models that accommodate behavioural analysis which could integrate the analysis of cognitive abilities as well as the behavioural patterns of the decision maker (Schrager and Madansky, 2013).

Classical decision making (CDM) is based on the “rational choice” model; CDM “postulates the formation of a utility function and a subjective probability distribution, with subsequent maximisation of subjective expected utility” (Schrager and Madansky, 2013, p82). For one to be rational, one needs “an elicitation of each possible action as well as a consideration of all possible intermediate events and contingencies” (Schrager and Madansky, 2013, p82). In reality, “people do not conform to the “reasonably sounding” postulates that underlie CDM because “it is beyond human mental capacity to enumerate, let alone keep in mind, all this required data”; as a result, the “decision maker looks only at a manageable subset of these actions, events, and contingencies in the formulation of his/her choice hence “satisfying,” some minimum desired utility level” (Schrager and Madansky, 2013, p82). This leads to a belief that, in reality, decision making is a practical, not theoretical, exercise, often with an associated sense of urgency and immediacy such that by the time one lists all the possible actions it would be too late to make a valid decision (ibid).

2.6 Impact of Decision Theory on Total Risk Assessment
Generally speaking, the management of risk and uncertainty has received great attention in the world; this is partly because “risks encompass both internal and external factors that are interrelated, influencing others in a causal way” (Lee et al., 2009, p1208); hence, it is important to identify the causal factors. Additionally, there are standard procedures used in the risk assessment process; however, these procedures lack a consistent decision making framework that can take into account the regional, cultural, social, political and behavioural attributes of the decision maker. One could argue that standard risk assessment procedures presume a level of competence – technical or otherwise – for a risk assessor, as long as they can follow a prescriptive procedure. However, such a presumption presents challenges in the real work environment due to the dynamic nature of the factors that decision makers have to
contend with, hence the need to adopt a more behavioural centric approach that can model not only the technical process but also the cognitive and behavioural factors of the decision maker (Wood et al., 2012).

2.7 Incorporating Beliefs, Human Behaviour and Bounded Rationality in Risk Assessment for this Research

For the research to integrate the issues concerning the social-cultural beliefs and personality to cognitive bias in risk assessment it is important to acknowledge and recognise that

“human behaviour is boundedly rational and that it is embedded in social norms and order has brought to light possible linkages between the adoption of simple modes of behaviour and persistent orientation to such norms. Such linkages have made it an important agendum to look into the possibility that human behavior may be better modelled by considering not only the need for simple modes of behaviour that can absorb bounded rationality but also the non-functional benefits from orientation to social and cultural norms” (Hayakawa, 2000, p4).

This means that the research recognises and understands that societal and individual beliefs, culture and human behaviour have great significance on the process of risk assessment. The risk perception and safety culture of the people working in the oil and gas industry in Kuwait and the Middle East in general need to be evaluated with full recognition of bounded rationality, personality, beliefs and the human behaviour of the decision makers, herein referred to as the psychology of risk.

Kouabenan (2009, p771) explained that “culture refers to a system of beliefs, values, representations, and shared experiences among the members of a given social group; it consists of views of the world shared by more or less overlapping groups of varying sizes. In the case of professional culture it characterises a group of trades or occupations; organizational culture, which defines the view unique to a particular organization; and class culture, which reflects the thinking of people belonging to a given social class”.
For the research to achieve a level where these factors are integrated in the risk assessment process, it is important to adopt the physical model shown in Figure 2-4 where classical decision theory can be examined separately before it can be incorporated into the descriptive decision theory. Thereafter, three key areas need to be examined and these include: (i) the behavioural theory of decision makers; (ii) the social-cultural factors for decision makers and (iii) the personality of the decision makers.

**Figure 2-4:** Mapping the decision and behavioural theory to the psychology of risk
2.8 Pavlov’s Dogs Theory of Psychology and the Standardised Response to Health and Safety Risks

From the decision making theories in section 2.2 to the influence of personality in section 2.5, we can observe how powerful psychological influence can be on human decision making. This phenomenon can be explained in psychological terms by using Ivan Pavlov’s theory of conditioning response (Pavlov, 1897/1902). According to Cherry (2013)

“Pavlov and his assistants would introduce a variety of edible and non-edible items and measure the saliva production that the items produced. Salivation, he noted, is a reflexive process (Pavlov, 1897/1902). It occurs automatically in response to a specific stimulus and is not under conscious control. However, Pavlov noted that the dogs would often begin salivating in the absence of food and smell (Pavlov, 1927). He quickly realized that this salivary response was not due to an automatic, physiological process. Based on his observations, Pavlov suggested that the salivation was a learned response. The dogs were responding to the sight of the research assistants' white lab coats, which the animals had come to associate with the presentation of food. Unlike the salivary response to the presentation of food, which is an unconditioned reflex, salivating to the expectation of food is a conditioned reflex”.

Editorial (2009a) reasons that the psychology of conditioning has played a key role in the explanation of the way people get used to conditions such that their response can be limited to the reflexes they have learnt within conditions, meaning that the understanding learnt from dogs’ responses in the area of conditional response may have relevance for social cognition skills, hence the relevance of the theory to psychology (Call et al., 2003, p229). Therefore, Pavlov

“recognised that there are two types of reflexes: unconditioned and conditioned. An unconditioned reflex is an innate response to stimuli that occurs naturally, without any learning involved. For example, when you are driving a car and enter a dark tunnel in daylight, your eyes automatically adjust to the change in light. However, a conditioned reflex is a learned
response, as when you see a red light, you automatically put your foot on the brake. You have acquired an automatic response to stimuli — a conditioned or learned reflex, a habit” (Blumenfeld, 2008, p33).

The relevance of Pavlov’s Dogs Theory to the psychology of risk is that the culture of response can be learned by conditioning (Plaud and Wolpe, 1997; Pavlov, 1897/1902) and with regard to the standards of assessing risk for the health and safety of the workforce, it is possible that the response would be a learnt one. Yet the main issue about unconditional response leaves open the possibility that there can be instances when unconditional response takes place to the detriment of the health and safety of the installations and the workers therein. The innate response is unpredictable and is based on nature, yet the conditional response can be driven by the culture or social setting of the working environment, as was demonstrated in Pavlov’s experiment (Pavlov, 1897/1902); hence the need to constantly assess the conditions of social and cultural beliefs by risk assessors.

2.9 Summary

The classical theory of decision making discussed herein has demonstrated that there is a fundamental belief about the decision maker that, under normal circumstances, he/she is seen as one who weighs all the available options and that the decision made can be assumed to be the most ideal considering the circumstances given. However, this stance has been discredited as one that is honest but fundamentally flawed because human beings are said to be bounded in their decision making. The chapter has also demonstrated that the process of decision making is riddled with influences and bias such that the ultimate decision, if unchecked, could turn out to be wrong. Therefore, personality, beliefs and human behaviour have been cited as some of the key factors influencing the decision maker. The theory of decision making is extremely vital for the oil and gas industry because of the volatility of the product and the dangers it poses to the workers and society in general. The production processes for oil and gas are inherently hazardous mainly because of the vast amounts of flammable hydrocarbons that are either stored or processed at any facility (Pinheiro et al., 2011, p34); therefore, it is imperative for workers to perform risk assessments. Most organisations have formal risk assessment techniques that are recognised by the international community; however, these techniques for assessing risks demand that risk assessors make decisions.
According to Pinheiro et al. (2011, p34) decision making and evaluation is extremely necessary at

“various phases of the asset life cycle as they help personnel identify, evaluate and control hazards that could result in loss of life, injury, pollution, property damage or business disruption”.

In addition, these decisions are bound by employment and safety law in many countries. Therefore, one cannot afford to make poor decisions in such an important industry. However, research shows that people have continued making mistakes in their decision making within the oil and gas industry resulting in many accidents around the world. For instance, Bjerkan (2010) analysed the relationship between health, environment, safety culture and climate and how these related to occupational accidents in Norway. She discovered that there were significant “correlations between health, safety and work environment” (Bjerkan, 2010, p445). Each group that she studied within her sample showed varying levels of perception related to the psychosocial work environment and that the perception of the work safety climate varied from group to group (ibid). Therefore, the work environment was found to contain subjectivity in the way occupational health matters were dealt with and incidents took place to a varying degree depending on the perceptions that people had. Another noticeable element was that the people made decisions in accordance with the way they perceived the work environment as well as the way they decided upon noticing stimulant factors in their decision making process (Bjerkan, 2010, p445).

It is therefore important to understand how the work environment – herein termed the external environment – (Figure 2-3) could create sensory stimuli which could trigger social, cultural, religious and personal factors in decision makers so that their decisions, at the end of the day, could be rational and irrational at best. We may not be able to predict the outcome, however, the organisation could take into consideration the behavioural, perceptual, cognitive and social bias in the decision making process which have an impact on the occupational health of the people employed in oil and gas refineries. These are subjective elements in risk assessments; however, Bjerkan (2010) recommended highly provision of work safety climates and perception of the work environment in the risk assessment processes for the oil and gas industry. We can only allow for an inclusion of such factors if we have examined the principles of bounded rationality in the decision making process and how biased a risk assessor could be at any point in time.
Pinheiro et al. (2011) acknowledged that it is normal for an organisation to create formal risk assessment tools that are prescriptive, depending on how the facilities have been designed such that the workers could follow through the motions; however, when there are changes to the process, the worker might not respond as effectively as they can if they have had flexible risk assessment tools. What decision making can do is to free workers from dealing with restrictive risk assessment tools by allowing them to include flexible factors that move in tandem with societal factors such as emotions, commitment, personality, beliefs and behaviour. Unless these factors are examined clearly, risk assessment tools are bound to be restrictive and unresponsive to the modern day oil and gas industry that still poses dangers to the worker.
3. **CHAPTER THREE: REVIEW OF LEAN MANAGEMENT AND ITS INFLUENCE ON OCCUPATIONAL HEALTH AND SAFETY RISKS**

3.1 **Introduction**
The hydrocarbon industry is riddled with accidents and incidents over the years, that can be partly blamed on “cost cutting” driven risk assessments (Lean, 2010). For example the BBC (2011) summarised the BP Gulf of Mexico incident as one caused by “management failure”, cost cutting on safety measures and the lack of controls that ensure safety. Even though the report called some of these factors “cost cutting”, the company would argue that their system of operating could fall under the principles of lean management whereby a reduction in waste is one of the daily operational requirements. Naturally, companies strive to promote efficiency while reducing waste by applying "lean management" practices; some do this with a more explicit application of lean management, by constantly improving work processes (Al-Sudairi, 2007), while focusing on client and supply chain needs, as well as defining established value systems. The epicentre of lean management is the elimination of waste for any industrial setup (Bombach, 2007). However, when the processes are too lean, accidents may ensue, putting the facilities, workers and the business at risk. Even though the hydrocarbon industry has reliable quantitative risk assessment techniques that may incorporate probabilistic measures to predict the likelihood of systems failure, there are times when a “human call” is cardinal in decision making (Wang et al., 2011).

This chapter aims to demonstrate that, while companies may wish to promote efficiency in the industry, there is still a high level of human involvement in risk assessment processes that could be impacted on by the social-cultural and psychological attributes of the risk assessors. It critically examines how the application of the lean concept in the hydrocarbon industry could be promoting (or otherwise) biased judgement in risk assessors resulting in poor occupational health and safety conditions for the workforce.

3.2 **A Critical Assessment of How Making the Risk Assessment Process Lean Induces Biased Judgement**
It is a normal business practice to apply lean management as a system to reduce waste and improve efficiency (Eriksson, 2010). In project based industries such as construction, the on-
going dynamism of the production processes can impact on the application of lean management (Eriksson, 2010, p394). If the production process is intermittent, an organisation can still eliminate and or reduce waste and sources of waste by focusing on final performance targets as a means to identify non value adding activities (Jørgensen and Emmitt, 2009).

In the case of the hydrocarbon industry, applying lean processes involves “walking” a thin line between safety and cost saving decisions. This is because, when the processes are too lean, accidents may ensue meaning that there is a fine balance between lean management and unnecessary cost cutting processes that may put the facilities, workers and the business at risk. There are quantitative risk assessment techniques that may incorporate probabilistic measures to reliably predict the likelihood that a system might fail; however, most times there is a human call in the decision making process (Wang et al., 2011). Even though the risk assessment of lean management decisions involves people, the risk assessment tools are too rigid to fully account for the social and cognitive bias in the decision making.

3.3 Lean Management: Lessons from the Construction Industry
Generally, the construction industry integrates various elements of engineering professions thus providing a platform from which lessons could be learned. In the construction industry, the "idea of lean thinking comprises of a complex cocktail of ideas including continuous improvement, flattened organization structures, teamwork, elimination of waste, efficient use of resources and cooperative supply chain management" (Pheng and Fang, 2005, p524). For example, Jørgensen and Emmitt (2009, p226) observed that the construction industry in the UK has been applying the lean thinking philosophy since the recommendation from the “Egan report” in 1998 which basically implied that lean in construction involves a three way issue of “waste elimination”, “partnering” and “structuring the context”. Al-Sudairi (2007) noted that even though lean can mean different things to different people, its principles can make construction processes more efficient. The challenge, however, is that the process which determines whether there is “waste” or not needs to be transparent. Eriksson (2010, p394-396) explained that there should be: (i) a process that can focus on detailed planning and control, resulting in detailed knowledge of the processes and work flow; (ii) a focus on the customer, especially on maximising the value to the customer (Salvatierra-Garrido and Pasquire, 2011, p9); (iii) a focus on the long-term perspective of “continuous improvements – [also called “Kaizen in the Toyota Production System] – so as to increase efficiency over
time; (iv) a focus on cooperative relationships with supply chain actors and (v) the ability to increase efficiency by adopting a systems approach in the work process.

The main lesson from the construction industry is that an organisation would get full benefits from lean management when all the key elements are applied in tandem. For instance, Lean (2010) reported that the British Petroleum (BP) Gulf of Mexico accident of 2010 was caused by – inter alia – unnecessary cost cutting measures on key elements of the production system. It could, therefore, be argued that the application of waste reduction within the risk assessment processes of the hydrocarbon industry would lead to a lot of lessons being derived from the way lean management has been applied in the construction business since the late 1990s.

3.4 “Cost Cutting” or “Waste Reduction” in Risk Assessment Processes

The ultimate goal for the hydrocarbon industry should be to apply lean principles that can foster reduction of “waste”, not the “cost cutting” approach that has been known to increase the risk of causing accidents (Lean, 2010). Generally, lean philosophy processes are applicable in many situations where management needs to simultaneously reduce waste and increase efficiency, on a continuous basis. For instance, Meiling et al. (2012, p141) explained that continuous improvement implies an incremental, ongoing effort to improve products, processes and services, and that it should be viewed as a “process intended to achieve improvement” rather than a series of isolated improvement activities. The BS 3010 (2010, p10) promotes a continuous risk assessment process which can be used to reduce threats to the business while taking advantages of the opportunities. Additionally, continuous improvement drives “continuous learning” from incidents for the safety of industries such as oil and gas, argued Saw et al. (2010).

For an organisation to effectively implement lean management through continuous improvement, Meiling et al. (2012, p142) proposed the use of the 4p model consisting of: (i) philosophy that can promote long term thinking; (ii) processes that can eliminate waste; (iii) people and partners to work and (iv) problem solving. In the case of risk assessment processes, failure to use the 4P may result in accidents. For instance, Lean (2010) cited weak risk assessment procedures and cost cutting measures as crucial reasons for BP's belching oil well in the Gulf of Mexico in 2010. Even though companies may have technically sound
procedures, decisions for risk tend to be made by individuals. These decision makers are prone to influence from their social-cultural biases.

3.5 Cognitive and Social Desirability Biases in Risk Assessment
The word ‘bias” means “a strong feeling in favour of or against one group of people, or one side in an argument, often not based on fair judgement” (Oxford Advanced Learner's Dictionary, 2011). The bias under consideration herein has to do with being “connected with mental processes of understanding” – herein called cognitive. Cognitive bias has been one of the fundamental reasons for judgmental flaws when it comes to technical reasoning and or decision making such as risk assessment, because a biased analyst ignores evidence and follows his/her “gut feeling” about things that could otherwise be interpreted differently (Kahneman and Tversk, 1972). There are many areas of professional specialisation where people may believe that biases are difficult to come by because, on average, the data used would even out over the time period, reported Oechssler et al. (2009, p147).

The other key source of bias is “Social desirability” (SD) which is widely understood to be the tendency by people to deny socially undesirable traits or behaviours and to admit socially desirable ones” (Randall et al., 1993, p186). The argument has been that every society has people that can have a negative perception and value of certain attributes such as theft, gambling and the like, and that the same set of people in the same society may have a positive perception and value of particular attributes such as hard work, religious inclination and or support for the family (Randall et al., 1993, p186).

However, if they are to be confronted about their own way of thinking about a certain event and or about their own feelings towards an issue, they will try hard to hide that which they feel is true so that they may conform to the expected social norms that are prevalent in that society. This means that “social bias, usually called attributional bias, affects our everyday social interaction.

3.5.1 Evidence of Cognitive and Social Bias in Risk Assessment
Applying cognitive and social bias to risk assessment has been evidenced in many ways. For example, Baker Jr. and Maner (2009, p1136) explained that risky decision making is shaped by people’s emotions and goals. However, society needs to specify the underlying social
functions that risk-taking may be designed to serve. In fact, culture and social connections have a significant role to play in the manner in which people assess risk and choose to manage that risk (Reynolds, 2011, p206).

Depending on the individuals, communities and societies at large, perception of risk and how it’s communicated varies from place to place. Because the assessment and communication of risk it multi-faceted (Reynolds, 2011, 207), organisations use standard tools and processes to manage risk. However, these tools can be mechanical, inactive and reactive to incidents (Corotis, 2009). They fail to encompass dynamism in the way risk is understood and communicated because they do not adapt to social cultural requirements such as education, language and communication styles (Reynolds, 2011, p207). For instance, if people feel unfavourable towards an activity they would judge it as having high risk and low benefit (Reynolds, 2011, p207).

Therefore, it can be argued that current risk assessment processes are limited in the way they can be used on a daily basis in hydrocarbon facilities such as oil refineries where there are constant threats to operations such as fire and the like. Biased risk assessment, however, may not be argued to be the "sole" causer of accidents in the industry; however, it is crucial to adopt risk assessment systems that can incorporate social and cultural bias tendencies within the teams.

3.6 Business Operations in a Complex and Uncertain Oil Refinery Environment
Throughout the world, the oil and gas industry has some of the most complex installations that form systems for extracting natural resources, purification and or transporting them from some of the most difficult environments. Despite the difficulties associated with oil and gas, industry investors clamour to partake of any chance for investment because of the market demand for oil. Like any industry, if the standards of quality, safety and management are adhered to, there tend to be no visible risks, until an event such as the Caracas oil explosion of 27th August 2012 which killed 44 people, reported by Neuman (2012). It was reported that despite the warning signs of “smell of gas” there was no action from the company to deal with it until the threat materialised. There are many factors that could contribute to the materialisation of a threat such as a fire, depending on the operator of the refinery, the country where its operated from and the manner in which the refinery is maintained.
Regardless of the location and or maintenance programs that an organisation may have, the sheer complexity of the industry plays a key role in the way an organisation could uphold the safety of its installations by instituting a risk assessment regime that could reduce the likelihood of threats materialising and or the impact that they may have on the market (Saleh and Pendley, 2012). However, despite the best efforts of risk assessments there are times when it can be nearly impossible to predict a future event that could change the way a company operates it if were to materialise.

This chapter examines the complexity of the oil and gas industry as well as the dynamic nature of the factors that can impact risk assessment systems used in the industry. It concludes that the dynamism of the industry introduces uncertainty into the risk assessment approach to the extent that accurate modelling becomes almost impossible. However, it recommends an introduction of a dynamic risk profiling process that would constantly allow for the introduction of uncertainty and human psychology in the risk assessment process.

3.7 Complexity of the Oil and Gas Industry of Kuwait

Kuwait has a variety of ways to recover hydrocarbons; the most recent has been the use of steamflooded enhanced oil recovery systems whose technology has been designed to recover heavy oil. Because of the high viscosity of the heavy oil, Gonçalves et al. (2009, p2) explain that “cyclic steam injection is focused on oil viscosity reduction and cleaning effects around the wellbore. The process consists of a combination of injection, soak and production periods in order to heat the well vicinity and improve oil production by natural drive forces. Dimensioning of cyclic conditions depends on the reservoir characteristics, flow rates and financial return”. In other words, the process of steam injection in heavy oil wells is aimed at reducing the viscosity of the oil for easier recovery. There are other oil recovery systems that are used not only in Kuwait but also around the Middle East and North African (MENA) region that are complex enough to warrant a robust risk assessment process. Many oil and gas operations are operated by contractors and subcontractors with a varying operational and business background (Chevron, 2010) and with varied workforces that have different social-cultural backgrounds. Even though the operations are often as stable as possible, there is a likelihood that a one-off chance could trigger an unwanted event such as an explosion, like the one that happened at Venezuela’s largest oil refinery over the 26th August 2012 weekend (shown in Figure 3-1). After the incident in Venezuela, there was “a barrage of criticism at
the government’s management of the state-run oil company, Petróleos de Venezuela, stating that the company had neglected essential activities like maintenance, safety and the development of new sources of production” (Newman, 2012).

![Figure 3-1: Residents near the Amuay oil refinery in Punto Fijo, Venezuela, ran to safety when a gasoline storage tank exploded on Monday 27th August 2012 (Picture by Meridith Kohut for The New York Times)](image)

Even though the oil and gas recovery plants in Kuwait are different from those of Venezuela, there are similarities in many ways because they all handle flammable products and they all require vast amounts of money upfront before they can be operational. This means that the complexity of the oil and gas recovery system have an inherent physical complexity as well as operational complexity.

### 3.8 Complexity Driven Safety Culture in the Oil and Gas Industry

According to Mearns and Yule (2009, p777) the issues pertaining to risk in the oil and gas industry abound; they may either be evident in the form of occupational safety or the safety of equipment used in the complex industrial processes. However, because of the process of globalisation, there is a potential influence on the attitudes, beliefs and behaviour of disparate national workforces across the globe. By definition, the “safety culture of an organisation is determined by the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviours that determine the commitment to, and the style and
proficiency of an organisation’s health and safety management” (Mearns and Yule, 2009, p779).

It is a common phenomenon to find a multi-national oil firm around the world employing workers from disparate national cultures, working in geographically unique environments with challenges related to cultural assimilation, beliefs, training, education and experience (Mearns and Yule, 2009, p777); yet, they are expected to work in harmony and in accordance to the standards set by their employer. There is definite diversity in many ways in each and every instance. Even though the production process can be stable, there is a constant demand for assessing changes to the production process which requires that “a wide range of contractor and sub-contractor companies support the operating companies by developing infrastructure, offering engineering solutions and supplying and operating highly specialised equipment” (Mearns and Yule, 2009, p777).

The assumption that the workforce’s safe or unsafe behaviour is a function of the organisation’s prevailing safety culture is largely misplaced mainly because there is no causality established between safety behaviour and the safety culture of the organisation (Mearns and Yule, 2009). The implication of the assumption has been that when there is a positive safety culture, workers exhibit safer behaviour and vice-versa; however, there is no direct link between the two. One would argue then that, if there is safer behaviour, there would be a positive safety culture, but that has not been the case as there are negative work cultures in the industry, especially in the offshore sector where there is sometimes a ‘macho’ culture. Due to poor safety behaviour, attempts to change the culture are driven through: (i) engineered improvements; (ii) implementation of safety management systems and (iii) behaviour safety interventions (Mearns and Yule, 2009, p779).

Mearns and Yule (2009, p780) argue that the “collective programming” of culture that Hofstede referred to is mainly formed by values – which they termed as “a broad tendency to prefer certain states of affairs over others” – which implies that there are common mental programs that are shared by a group of individuals. This argument, however, is too general because national culture may be very influential at an oil and gas terminal staffed by workers with a different cultural background. This means that it is more difficult to disentangle the issue of “values and attitudes” towards risk based on national culture alone because there is evidence that the political, legal and educational systems have an impact on risk attitudes as well – where democratic legal systems and political systems and capitalist business
environments tend to be more inclined to have an influence while those of other cultures tend to be more averse.

3.9 Uncertainty Management within a Complex Oil and Gas Industry
There are many elements of uncertainty associated with the oil and gas industry. For this research however, uncertainty has been examined from the point of view of the data that it generated within industrial operations as well as that which is needed for the smooth operation of the industry. It also examines the uncertainty of the people that deal with the data within the industry.

3.9.1 Unpredictability or Uncertainty of the Data in the Industry
Industries that deal with volatile data have always found it extremely difficult to create a system that could be used to predetermine the result of their operating environment, thus making it extremely difficult to disentangle risks and opportunities with confidence. Orlowski (2012, p120) gave an example of the financial market which experienced a financial crisis from mid-August 2007 due to “extreme market risks” or “tail risks”, as statisticians would call them. The argument has been that “the prevalence and scale of tail risks for the financial market contributed to the unprecedented depth and propagation of the financial crisis of 2007 because the tail risk was deep and unpredictable” (Orlowski, 2012, p120). Generally, professionals have always grappled with tail risks, with the hope that it is possible to model the risks using sophisticated mathematical models; yet, the reality has indicated that tail risks have extreme outcomes whose data distribution of financial market variables can be said to be “abnormal” or (Gaussian) “leptokurtic” [meaning that there is a high concentration of data around the mean at normal times and wide dispersion at turbulent periods” (Orlowski, 2012, p120).

It is natural for people to take an objective approach to modelling the tail risks in many industries, but in the end, it is extremely complex to model the data because it goes beyond their understanding of the mathematical complexity – making it extremely difficult for one to predict the outcome. At best, there is a school of thought which argues that because of the complexity of nature, it is not possible to model all the data needed, or else it would simply mean presenting wrong information using mathematical modelling – technically lying.
To this end, Zaleskiewicz (2011, p384) reported that, because of the complexity of the data needed to model and predict with certainty the potential outcome of the variables on the market, “analysts who compare economic and psychological features of a crisis argue that making predictions has become much more difficult, claiming that in ‘the new economic reality’, regular economic cycles are absent, and upturns (booms) or downturns (recessions) are unpredictable”. Currently, there is no technical evidence that suggests that professionals are better than non-professionals when it comes to the accuracy of predictions using random data. This means that, as far as human psychology is concerned, laypeople have an equal chance of predicting wrong things as have the myriad of professionals who constantly get it wrong (Zaleskiewicz, 2011, p385). This means that as long as decision making is based on random figures, experts make the same cognitive errors as novices and this is why they do not produce better predictions, argued Zaleskiewicz (2011, p385).

There is another argument that poor quality expert judgement is also caused by the relative dynamism of the environment from which the data being used for prediction emanates. For example, “some professionals working in certain disciplines act in a very dynamic environment, where stimuli involve human behaviour, and conditions are highly changeable and barely predictable” (Zaleskiewicz, 2011, p385; Andersson et al., 2009). This makes it impossible for them to predict with accuracy any issue they may wish to know.

3.9.2 Examining the “Unknown Unknowns” in the Industry

Even though experts may think that they can easily predict with certainty the likelihood of future events materialising, it has never been easy to do, as far as history can recall (Elahi, 2011). This is because there are unknown unknowns about any data relating to any business around the world. According to Elahi (2011, p196) the modern practice of risk and uncertainty management are devoid of any undesirable and unrecognised elements that cannot easily be organised and controlled. There is an element of conspicuousness in the way undesirable and unrecognised elements are left out from the practice of risk and uncertainty management, argues Elahi (2011), meaning there is a deliberate generation of ignorance, uncertainty and risk within the spectrum of “unknowing”. Therefore, from the risk assessment perspective, unrecognised data or events are those that have been nicknamed “wicked problems”, “Black Swans” or “Post Norman Science” because they “are ambiguous, highly constrained, tightly interconnected complex social, technical, economic and political
dilemmas. Their changing nature and complex interdependencies make it almost impossible to define them collectively because there are so many different perspectives and issues at stake” (Elahi, 2011, p197).

3.10 Risk Modelling in an Uncertain Environment

It has been observed that most risk assessment systems have a deliberate way of avoiding “wicked problems” that emanate from uncertainty in the work environment mainly because, when uncertainty is extremely difficult to model, according to de Camprieu et al. (2007, p668), in an uncertain environment such as a project environment, the evaluation of opportunities and risks can be a complex interaction of objective and subjective factors. However, amongst the stakeholders there are those who may not know a single thing but would not wish to manage that which is unknown (Elahi, 2009). It is argued that “worse than ignorance of facts is ignorance of ignorance; the illusion of knowledge could then lead them confidently to disaster” (Elahi, 2009, p197); this simply means that for one to manage uncertainty or risk there is a need to base analysis on factors relevant to the issue. However, in the case of indeterminate uncertainty, this means recognition of the un-knowing” (Elahi 2009, p197). This means that uncertainty management implies the recognition of unpalatable and sometimes controversial issues that could be unwanted and unrecognised, things whose omission could be critical to the overall well-being of that which is under assessment. Therefore, ignoring unknown unknowns results in “sub-optimal decisions, unreliable trade-offs, erosion of institutional credibility and research implications of these sources unattended” things that cannot easily be managed through “command and control” tactics such as “management” or operations (Elahi, 2009, p197).

3.10.1 “Command and Control” Systems to Manage Uncertainty

There are existing models for risk assessment that have attempted to integrate as many elements of risk as possible, including such elements as finance, insurance, project management and the like (de Camprieu et al., 2007, p668). For instance, section 2 of this report has information that can be said to rely heavily on the “command and control” approach where certainty is the norm for the system to operate. The closest mechanism to managing uncertainty, according to de Camprieu et al. (2007, 686) is when project risks are analysed in terms of two risk components: (i) events that exogenous and endogenous factors could trigger and that would affect the success of a project. Events are represented by a
density function $f(y)$ and the probability of each event is a function of the risk factor; (ii) the amplitude of the impact of each event on the success of the project, if it occurs. Impacts are represented by the density function $g(x)$ and the amplitude of impact is also a function of the risk factors (de Camprieu et al., 2007, p686). Therefore, risk is conceptualised by a risk density function $h(x,y) = g(x/y)f(y)$ that combines the probability and the amplitude of the impact of these various events. Consequently, the concept of risk exposure often referenced in project management literature is a version of the risk density function:

$$ Risk\ Exposure = \sum_{i=1}^{n} P(X_i) \cdot C(X_i) $$

Equation 3-1: Risk exposure model (source: de Camprieu et al., 2007, p686)

Where $P(X_i)$ is the probability of an undesirable event $i$ and $C(X_i)$ is the consequence of the event. There is very little difference in the way the risk exposure equation has been designed because it ultimately cannot cover the greater details of unrecognisable and unwanted factors that are unknown. In order to allow more factors in the risk exposure model, people develop variables that may not necessarily be used with the equation, rather they would simply mention them in various risk assessment documents.

According to de Camprieu et al. (2007, p686), the perception a person develops of the risk of a project is a function of three sets of variables:

- The risk factors (exogenous and endogenous) that the person will consider in assessing the risk of the project;
- The perceived probability of each salient factor having an impact on the project;
- The perceived magnitude of the impact of each salient factor on the viability or performance of the project.

Independent variables include: cultural factors; individual factors; social economic factors and situational factors. Such factors strive to mimic the unknown factors at the risk assessment stage. Coming up with independent variables is largely affected by the “cultural” inclination of the team. There are several questions regarding the influence that the cultural variable could exert on the individual process of risk assessment. When they evaluate the risk
of a project, do people from distinct cultural environments differ in terms of: (a) the types of risk factors they consider and relative importance attached to each factor considered? (b) the relative importance attached to the perceived likelihood of occurrence of each individual risk factor? (c) the relative importance . These factors have to be answered in conjunction with other independent factors (cultural, social-economic, individual and situational) (de Camprieu et al., 2007, p6867). Figure 3-2 summarises some of the key factors necessary to arriving at a formidable risk perception; however, “wicked problems” may not be found on the template of Figure 3-2.

![Figure 3-2: Concept of project risk perception (de Camprieu et al., 2007, p687)](image)

### 3.11 Uncertainty Avoidance: a Cultural Issue
Culture plays a critical role in the management of uncertainty. Depending on the national culture of an individual, there are instances when one can avoid uncertainty; this means that some risk and uncertainty profilers can naturally be affected by their cultural beliefs, hence creating a situation where biases are introduced in the risk assessment scheme.
3.11.1 Understanding Culture using the Hofstede Model

Taras et al. (2012, p329) quoted Hofstede who defined culture as the collective programming of the mind which distinguishes the members of one human group from another: a multilayered construct represented by values, practices and artefacts. In the work place, Holt and Wigginton (2002, p287) define culture as the value systems that allow a group to be cohesive with regard to a factor that makes them work together. Culture is a key element of human behaviour because if influences the way people behave towards things. To understand culture, it is advisable to use the Hofstede’s four dimension model as a tool to profile a culture of interest for research. Taras et al. (2012, p330) explained the four dimensions of the Hofstede model (Figure 3-3) as follows:

- Power distance – the extent to which the less powerful persons in society accept inequality in power and consider it normal;
- Individualism – the degree to which people prefer to act as individuals rather than as members of groups, primarily looking after their own interest, while in collectivist cultures people are assumed to belong to tight in-groups that protect the interests of its members in return for loyalty. It is observed that a culture with a high score in “individualism” can mean that there is emphasis on personal achievement, innovation, autonomy and adventure (Holt and Wigginton, 2002).
- Masculinity – the degree to which masculine values like assertiveness, performance, success and competition, prevail over feminine values like quality of life, maintaining warm personal relationships, service, care for the weak and solidarity. A society scoring high on masculinity tends to value decisiveness, assertiveness and competitiveness (Holt and Wigginton, 2002).
- Uncertain avoidance – the extent to which people are made nervous by situations which they perceive as unstructured, unclear or unpredictable. Any culture that scores high in “uncertainty avoidance” is one that seeks to reduce ambiguity, meaning that members are uncomfortable in unstructured situations (Holt and Wigginton, 2002).

Mcgrath et al. (1992, p117) reasoned that in the early 1960s there was a perception that there were a limited number of societal problems in every country and that only a limited number of known responses could be used (p117). The fundamental problems back then included: (i) the nature of human nature; (ii) the relationships of man to nature; (iii) orientations towards
time; (iv) orientations toward activity and (v) the nature of relationships between people. The Hofstede four dimension model was one of the key tools used to understand culture back then and could have solved the fundamental problems aforementioned. However, such a narrow view of society could not function in today’s complex industrial setup where national boundaries have been broken due to international movement of employees. This assessment implies that people of different national cultures with different perception of societal orientation would have a different approach to dealing with risk.

![Diagram of Hofstede’s Cultural Dimensions]( Source: Holt and Wigginton, 2002 )

The Hofstede’s model of culture has been used in various ways especially in dealing with a range of organisational and national issues, including leadership, team work, justice, communication, ethics and the like. However, Hofstede’s cultural indices have their
limitations especially in terms of their generalizability because of the limited representation of the sampled population at the time of the research (p329). Naturally, culture around the world is dynamic and this makes it harder to apply the model to uncertainty management because it could be outdated. For this research there is also an issue of national culture and how it can be used to profile risks for the MENA region, considering the perceptions people have towards Arabs.

Taras et al. (2012, p 333) argued that uncertainty avoidance is likely to be the most dynamic of the dimensions. Preference for clarity and certainty can change rapidly, reflecting the present economic and political stability. In times of crisis, preference for stability and the need for clear rules and guidelines increases, as was the case in the US after the 9/11 attacks. Not surprisingly, uncertainty avoidance has been shown to correlate with indicators of economic, political and societal problems such as inflation, corruption, criminal risk and unemployment. Another example that can be used to assess the ineffectiveness of the model is reported by Slangen and van Tulder (2009, p276) who stated that “cultural distance is a wrong predictor of the political risks that a company can be exposed to. In other words, international companies do not understand the real impact of cultural distance on the perception of risks and the fact that using cultural distance as a factor leads to sub-optimal assessment of risks for a business.

With an increased influence of global values, it is possible that the uncertainty of the oil and gas industry can also be affected like any other industry. Arnett (2002, p779) opined that western culture in general promotes individualism through the free market economy, democracy and capitalism; it is a culture that has been appealing to the global audience and is much sort after and embraced around the world; however, not all local cultures accept the western version. They still maintain fundamental religious values that influence the habits and traditions of the people.

The influence that global culture has on people promotes individual choices as opposed to promoting conformity with traditional values, and such an approach can be difficult in situations where social and traditional conformity is expected (Mearns et al., 2004; Mearns and Yule, 2009).
3.11.2 How Professionals Avoid Uncertainty

There is no deliberate strategy that professionals use to avoid uncertainty, except their cultural behavioural tendencies (Rieger and Wang, 2012, p64). Rieger and Wang (2012, p64) explain that sociologists have developed standardised and quantifiable measures that capture several parameters of culture – such as the “cultural dimensions” concepts by Hofstede. There are other behavioural models such as loss aversion from the prospect theory, and disappointment aversion which have also been proposed. Some models modify the probability distribution by taking into account rare, though disastrous events, idiosyncratic income shocks and survivorship bias (Rieger and Wang, 2012, p66-70). However, it has been noticed that culture still drives uncertainty avoidance.

This has led to the generation of “the uncertainty avoidance index (UAI) by Rieger and Wang (2012, p70) which “measures the degree to which people prefer to avoid ‘‘unclear’’ situations, e.g., at work”. In their survey, the country that scored highest on their scale was Greece (UAI = 112), where traditional culture is rather fixed and people try to avoid situations without predefined ways to handle them.

![Map showing the distribution of uncertainty avoidance around the world](image)

**Figure 3-4**: Distribution of uncertainty avoidance around the world, as measured by Hofstede. The darker a country, the higher its uncertainty avoidance index; White: no data available. (Source: Rieger and Wang, 2012, p70)

The lowest score of the UAI was Denmark at 23, which means that Danish people seem not to fear unclear situations. Figure 3-4 shows the map developed by Rieger and Wang (2012, p70) and the uncertainty avoidance index as measured by Hofstede. From the map, one can clearly see that there are systematic differences between cultural regions as well as those at the national level.
3.11.3 How Human Psychology and the Desire to Control Impairs Judgement

From a psychology point of view, uncertainty needs to be approached in a pluralistic way which assumes that the substance of any given reality may never be totally collected, that some of it may remain outside of the largest combination ever made (Smythe and McKenzie, 2010, p228). This means that uncertainty can be viewed with no prior limits on the extent of the uncertain factors in a given situation. Therefore, the innate desire to exercise control over uncertainty is a normal human psychological phenomenon, according to Elahi (2011, p197). However, when applied to the way people perceive risk, it is likely to influence human judgement in terms of how able one is to control the risk or not, as well as how well known the risk is in science terms. “Unexplained or incomprehensible events have qualities that amplify and extend their emotional impact. Because they are perceived to be out of the ordinary we are more likely to keep thinking about them, trying to make sense of them in order to avoid future similar occurrences” (Elahi, 2011, p197).

Due to the desire to exercise control over uncertainty, the convention of science has been drafted in as an objective mechanism that could validate the data needed for control. Elahi (2011, p197) explained that the “very essence of science is the notion of conjecture and test” – which means that when a hypothesis has been set, data can be collected to prove it and if, in the future, some information comes up to refute the current theory, science modifies the theory. This element of “conjecture” makes science a dynamic process that accepts and encompasses fallibility while taking evolutionary trends as it accepts more theories that can replace earlier theories (Elahi, 2011, p198). “However, the historic success of scientific thinking in driving rapid and radical technological innovation and the accompanying economic growth has meant that in practice it has become almost impossible to challenge the trajectory of scientific endeavour and the inherent risks the new technologies it spawns might pose” (Elahi, 2012, p198).

It can therefore be argued that even though a scientific approach to controlling uncertainty can be undertaken, it may not mean that uncertainty has been understood because the “wicked problem syndrome is a possibility. The reason for failure of science is that it takes the approach of “abstraction and analysis” where the former is a process “to establish organising principles that enable scientists to deal with large groups of ideas and things on the basis of their common features” while the latter is “the process that enables scientists to fragment a subject to the smallest possible scale” (Elahi, 2011, p198). Therefore, abstraction uses a narrow lens view that promotes the perception that the modern world is ordered and
predictable; a reductionist approach assumes that a “detailed under analysis is representative of the whole – thereby ignoring the innate complexity of many human and natural systems” (Elahi, 2011, p198).

Therefore it can be argued that even a scientific approach to the measurement of risks, rational as it may seem, is not able to deal with uncertainty. Nearly all risk and uncertainty measures that are based on statistical theories, game theory and the like have a common underlying assumption of “rationality” – a model that is “underpinned by the perception that uncertainty has been bounded and that risks can be identified and controlled – the inconvenient “wicked problems” therefore successfully ignored” (Elahi, 2011, p199).

3.12 Maturity of Uncertainty Management in the Oil and Gas Industry
There is evidence that the oil and gas industry around the world has been trying to manage uncertainty, to an extent that the management models for uncertainty have been presumed to “mature”. The argument has been that the ideas, beliefs, attitudes, opinions and principles long cherished by members of a society have an influence on the perception of risk (Karlsen, 2011). Yet, they cannot easily be linked to success and or failure of the risk assessment processes. Figure 3-5 illustrates the key factors that make up the uncertainty management maturity model, developed by Karlsen (2011). However, the model only covers the processes, the application, experience and culture, yet the social-psychological values could be added to the model, as shown by the light green process on Figure 3-5.

![Figure 3-5: Uncertainty management maturity model (Adapted: Karlsen, 2011)
The uncertainty management maturity model (Figure 3-5) can influence the organisational climate, Karlsen (2011) argued, in that it aggregates the attributes of the organisation such as “attitudes, feelings, and modes of behaviour which characterise life in the organization”. Karlsen (2011) also noticed that within the organisation, culture has a bearing on an “organization’s values, beliefs, practices, rituals, and customs”. This implies that for any organisation, “safety in the workplace should be a cause of concern for organizations and employees given that the social, physical and psychological well-being of workers depends on a safe work environment” and “thus organisations must find ways to best communicate hazard information to their workers and promote safety in the workplace” (Perez-Floriano and Gonzalez, 2007). For example, Davies (2002) reviewed the risk standards of the UK nuclear industry and found out that, at some point, risk management processes were centred on certification processes by licensed risk assessors accredited by the health and safety executive (HSE) and that there has been a movement to use probabilistic approaches to the evaluation of risks, including reviews every 10 years. While the procedures and systems have been strong enough, sometimes events occur that could not have been envisaged.

For instance, with the best of safety measures, it was not possible for a mature oil and gas company in British Petroleum (BP) to foresee the gulf of Mexico disaster in 2010 (BBC, 2011) shown in Figure 3-6. One of the reasons for this was that there is an overemphasis on procedure and systems that are abstracted from reality.

![Figure 3-6: BP Gulf of Mexico accident of 2010 (Source: BBC, 2011)](image-url)

For instance, Davies (2002) dwells so much on the procedures, regulations and safety without reference to the fact that these tasks are performed by people. The only reference to the
people relates to “licensing” and is an all-encompassing statement assuring the reader that the social-cultural aspects of the assessors could have been taken care of by the licensing of the assessor. This is a major weakness in current technical risk management strategies because decision makers’ social-cultural values are not considered as vital to the process in a formal way. Elahi (2011, p200) argued that if the industry used scenarios as meta risk analyses it might be possible to use human powers of foresight to allow people to imagine what has not yet happened in order to protect ourselves from the harsh realities of actual experience.

3.12.1 Cycle of Decision Making and Risk Management in the Oil and Gas Industry

“A key factor in achieving successful management policies in the oil and gas industry is the availability of adequate and reliable records of generation rates, characteristics, and distribution of different wastes produced by the industry; this is irrespective of the fact that such rates and distributions are highly site-specific and significantly vary from one location to another” (Elshorbag and Alkamali, 2005). This means that there is a correlation between the management of risk and the risk assessment policies of an organisation. For instance, HM Treasury (2004) developed a model on which an organisation could base their policy for the management of risks in their business. The model explains that the capability of leadership (BS 31100: 2008), policy and strategy, people, partnerships and resources and processes can lead to a more robust system that can integrate qualitative and quantitative mechanisms in risk assessment. While the risks in the hydrocarbon industry are plentiful, so are the business chances. If, however, operational risks are not properly contained, they can impact on the environment, especially on the communities around the refineries. Aven and Vinnem (2005) developed a model that abstracted the decision making process (Figure 3-7) from the organisational and strategic level – denoted by (1) – to the decision problem and alternatives (2), the analysis and evaluation of risks (3) and the management review and judgement (4) before the main decision can be made.
Regardless of the method used, a decision can only be made if there is management review and judgement – whose characteristics are qualitative at best. One could argue that the “management review and judgement” section of the model in Figure 3-7 carries, among other things, the key elements of social-cultural values that can drive a manager to perceive risk in their own way, over and above the technical elements that they may know from their day to day operations. Take for instance the general risk assessment and risk assessment based on the hazard and operability (HAZOP) and hazard identification (HAZID) (DoE, 1996) studies; no matter how technical the processes would be, there would still be a requirement for the “judgement” of the final outcome before decisions are made. This type of reasoning led Villani et al. (2006) to state that there are certain sources of uncertainty in safety systems relating to:

**People’s behaviour:** a number of reasons can make people behave in an unexpected way. One of the most important is fear. Different people react to panic in different ways. Some of them may face a dangerous path in a desperate attempt to leave the building. Others may simply run away from the fire as far as possible, even if it means not trying to leave at all. There are also people that do not know the escape route and may take a wrong direction, or take another route in order to find a family member.

**Out-break behaviour:** the uncertainty in this case is related to the conditions under which a risk event occurs. It comprises the kind of material that is burned, humidity, temperature and other air related variables, among many others.

**Equipment failures:** most of the time failures are due to inadequate maintenance or inappropriate use. The aforementioned factors are compounded by the fact that the
The hydrocarbon industry is a multi-cultural and multi-disciplined industry with workers from around the world with varied industrial experience.

### 3.13 Summary
The application of lean management in the industry is necessary because waste can be reduced and efficiency increased. The principles of lean management are therefore seen as essential in many industrial activities. The only problem has been that in the oil and gas industry, producing highly flammable hydrocarbon products on a shoe string budget is a recipe for industrial disasters. This happens when the application of lean production is abused to become cost cutting and as lean management is being applied, risk assessment is ignored in the process. The end result can be catastrophic because the occupational health and safety of the workforce and the surrounding areas can be put in danger. For example, the Caracas oil explosion in August 2012 and the Gulf of Mexico explosion in 2010 have both been attributed to the problem of lean management induced cost cutting measures whose risks materialised to cost even more money and fatalities.

Even though lean management principles are useful, there is a high likelihood that the application of the principle is riddled with biased assessment of risk. This factor, coupled with an uncertain operational environment, has resulted in the abysmal use of the lean management system. This chapter has demonstrated that those assigned to assess the risks when lean production is instituted could easily become biased through their cognitive or social desirability, hence invalidating the decisions that need to be objective. In an oil and gas refinery, the operations can be complex and the products have volatile attributes such that mishandling them could lead to compromises on occupational health and safety. This chapter has also shown that the complexity of industrial operations is compounded by the complexity of the uncertainties of the industry as well as the complexity of human intervention in the management of uncertainties.

Technically the industry has been developing mechanisms to improve the safety of the working environment; however, the human factors continue to plague the industry due to the social and cultural beliefs of the workers. Take, for instance, the research by Robb and Miller (2012) which examined the human factors related to engineering for the oil and gas industry. They reviewed the technical guidance standards, manuals and procedures. They discovered that there are many countries with good technical standards that deal with the “ergonomic factors such as machinery design, facility and accommodation layout and the organisation of
work activities” (Robb and Miller, 2012, p752). These standards have become essential, not only for the design of oil extraction and refining facilities around the on-shore and off-shore oil platforms, but also for the minimisation of occupational risks to the workers (Robb and Miller, 2012, p752). This means that companies can operate and maintain their facilities as well as improving the welfare of the people; however, the standards have failed to identify key factors that relate to human judgements. Robb and Miller (2012) explained that crew safety and efficiency is clearly understood but human factors are not well understood such that the deficiencies manifest themselves in accidents such as the ones alluded to (Gulf of Mexico, 2010). From the information provided in chapter three, one could critically argue that while the literature points to key indicators of the requirement for social-cultural specifications that may promote a robust risk as well as uncertainty management process, there is no evidence of such in the way the industry operates. This means that the gaps within the risk assessment processes may not necessarily be triggered by the technical competencies of the processes, but rather by the way social-cultural values that influence decision makers are incorporated in an organisation. These factors are some of the human factors that have been neglected as far as the risk assessment processes are concerned such that the end result has, at times, been catastrophic.

Therefore, the perception of risk could be said to be critically weaker because the standards have neglected the social, cultural and religious factors that drive humans. This chapter has therefore laid out factors that it is vital to test in the Kuwait Gulf Oil Company (KGOC) so that the workforce can realise the impact of social-cultural values on the risk assessment processes in hydrocarbon installations. Overall, the perception of uncertainty within the industrial processes has been such that every human factor could be rationalised and measured, hence the abundance of standard procedures that are used to promote transparency in the risk assessment process. The reality, however, is different, in that the factors cannot easily be measured but must be imagined. As such, human imagination could be useful in arriving at a holistic view of those wicked problems that cannot be modelled mathematically. Over-reliance on technical standards is a good thing, but it weakens the overall risk assessment strategies, hence endangering the occupational health and safety of the workforce. Therefore, human factors in decision making have to be considered in terms of human psychology as well as the appreciation of the social and cultural values of the society where the facility is being operated.
4. CHAPTER FOUR: A SYNTHESIS OF RISK MANAGEMENT IN OIL REFINERIES AND THE IMPACT ON OCCUPATIONAL HEALTH AND SAFETY

4.1 Introduction

The utilisation of a management philosophy in an organisation depends on many factors such as the management structure of the organisation, the ownership, i.e. privately owned and or publicly owned, and the business nature of the organisation. Most industries in the world deliver their products to an ever changing market at national and international level, with many challenges to the business. The British Standard (BS 31100:2008) argues that the application of risk assessment to business works well if the whole organisational approach to the business is perceived in such a way that opportunities as well as threats are part of the modus operandi. For an organisation to deal with business opportunities and threats (Johnson et al., 2009), they use many “strategic tools” to make choices that can shape the business to ward off competition. Strategy choices can also be used for the analysis of the industry performance. For example, it is common for organisations to review overall performance using the Political, Economic, Social, Technological, Legal and Environmental (PESTLE) analysis (BS 31100:2008, p28). The main approach to using this technique falls under the realm of “risk” to the industry because PESTLE factors form the source of threats and opportunities for the industry as a whole.

The aims of this research are (i) evaluating the impact of social-cultural values on health and safety management in oil refineries in Kuwait and (ii) assessing the pressure that lean management exerts on technical risk assessment processes within the oil industry. One of the objectives is that there is a requirement to “assess overall technical approach to integrated risk assessment in the purification processes of Kuwait, at all levels of management (strategic level to shop-floor level)”. Using the oil and gas industry in Kuwait and the MENA region, this chapter examines the details of the application of technical risk assessment for the health and safety of workers and installations in the hydrocarbon business, with a view to gaining a theoretical understanding of how integrated risk assessment is being applied as well as the impact it is having on the strategies for maintaining occupational health and safety in the oil refineries in Kuwait.
4.2 Application of Project Management in Dealing with Uncertainty

The oil and gas industry of any country can be operated using many projects from exploration to drilling, purification to transportation. As in any other industry, projects in the oil and gas industry deal with uncertainty in many ways. There is a common misconception that if a country has oil and gas wealth, they do not need to work hard in converting such wealth into goods and services for their people (Mehrara, 2009); however, reality is such that there are challenges in exploiting such natural wealth and converting it into a usable form so that the livelihoods of the nation can be sustained without jeopardising those of future generations. The use of project management as a key strategy in the delivery of facilities that can be used to exploit natural wealth has been crucial in Kuwait, hence the deployment of international contributors to facilitate that.

In the oil and gas industry, as is the case with most infrastructure projects, the level of mechanisation is unprecedented in the history of Kuwait because things such as welding, fixing and the like are all done using some form of construction technology comparable to those used in the developed world (Jenkins et al., 2005). Even though there are improvements in technology that lead to a better understanding of project characteristics, there are constraints that need managing, some of which include cost, schedule, quality and the like (Eldieb et al., 2005). Risk is another important constraint that needs to be managed. It is very important to model risk assessment and generate data that can be used to monitor the performance of the project from the risk perspective with a view to reducing incidents on projects.

Unlike the nations that report incidents in a robust and uninterrupted way, the Kuwaiti hydrocarbon industry needs to learn from the international industry in terms of how to develop and deal with risk so that it does not experience the incidents that could negatively impact on productivity and hence the economy. The backbone of the Kuwait economy has been its natural resources and other industries have been thriving as a consequence of a healthy hydrocarbon industry. Fraser (2009) reported that Kuwait has abundant untapped oil and gas resources and that it is a difficult place to do business. Because of the industrial potential emanating from the hydrocarbon industry, the political leadership has been working on attracting investment in financial services, construction, education and healthcare (Fraser, 2009).
There is room for improvement in many aspects of the oil and gas industry because the Kuwait Gulf Oil Company (KGOC) operates a rudimentary type of hydrocarbon industry, which has been the main source of revenue for Kuwait. This means that when the revenue from the oil and gas industry is impacted on in any way, other sectors such as education, health and general public expenditure are affected too. This means that there is potential for improvement in the industry. Because of the drive for national and international investment, project and programme management systems have been seen as the method that companies deploy in order to meet the infrastructure demand for the oil and gas industry.

History indicates that there are positive and negative impacts when foreign firms take over productivity in oil and gas (Blomstrom and SjoKholm, 1999) but the local partners need to manage the process if they are to maximise benefits (positive impacts) otherwise there can be negative impacts on society and the environment. For example, if incidents increase in the oil extraction process, it becomes inevitable that the risk assessment processes become accountable. Many contractors in Kuwait hire labour from Asia to support the equipment-intensive activities such as oil and gas (Wilkinson, 2007). Operatives obtainable from the international labour markets such as Asia are overly exposed to risks. Implementation of risk assessment on projects, therefore, requires a systematic approach to ensure the welfare of the workforce is planned and followed through. The scope for this research, however, is largely on the utilisation of an integrated risk assessment strategy for the oil and gas industry and an assessment of how the industry could benefit from systematic risk assessment in an integrated way.

4.2.1 Operational Uncertainty on Work Environments: Lessons from Project Environments

The first major factor to consider in carrying out a risk assessment is the “type of work” that employers and the public might be exposed to. Before carrying out a risk assessment, Gall (2008) stated that a company needs to reflect on what could happen to their business if there was an accident of one form or another. With this in mind, there could be various sources of risk depending on one’s business. In the oil and gas industry, risk and hazards are only reviewed from the perspective of “health and safety” or “fire” exposure to the people and the plant and equipment. By the time these hazards are reviewed, it would be too late for management to have a good influence (HSE, 2003). The work environments for the Kuwaiti Petroleum Corporation are similar to those for a hybrid of a “structured” organisation as well as a project based organisation. Of interest to risk assessment is the changing approach to the
management of projects as observed by scholars. For instance, Perminova et al. (2008) found that there have been changes in the approach of project management and how it is being applied in any industry. There is an emphasis not only on technical requirements but also on contextual and behavioural competencies that relate to the way a manager behaves in the context of a situation (Davies, 2004).

Instead of concentrating only on high value aspects of the project, there is a need to review things that can make or break the value system of a project (Hellstrom and Wikstrom, 2005). However, projects have not been known to use innovative combinations of products and services in search of competitive advantage but rather to ensure that business operates smoothly (Galbraith, 2002). At times, project environments have been too rigid, emphasising technical coordination only (Perminova et al., 2008) which ignores the integration of factors affecting risk assessment. Contrast this with a work environment of an oil and gas platform where stability is a necessity because lack of it might put the people, plant and equipment at risk mainly because of the volatility of the industry and of the product. One would therefore presume that the behavioural and contextual competencies would be necessary regardless of the angle upon which you look at the issue. Naturally, projects are very complex and uncertain, which emphasizes the need for greater flexibility and reflection as a new way of generating knowledge and functioning (Perminova et al., 2008). All projects are, to a certain degree, unique complex undertakings, hence experiencing project risk, which can be translated into overall business risk (Perminova et al., 2008).

When a project is viewed in isolation from the overall organisation, it is possible to lose track of the value adding capabilities of it. In this case, the business environment and its uncertainty play a crucial role in dealing with risk. The processes of the oil and gas industry are similar to those of the chemical processing industry, in that they would normally expose many people to risks in many ways. Essentially, it becomes difficult to assess the likelihood and the magnitude of the outcome within the processes, hence there is always a need to identify risks, assess them and report on how best to deal with the risks even though the business environment could be volatile (HM Treasury, 2004). Therefore, the strategic role of an organisation is to view risks of certain elements as integral to other operations, based on the risk assessment framework, such as the one proposed by the Office of Government Commerce (OGC, 2005) in Figure 4-1.
The OGC (2005) developed a framework that any businesses could use in managing the risks surrounding a business, at the individual or component level of operations. The critical factor is that once the operational level has been achieved, the information can be used to make a bigger and overall picture of the firm, hence the need for integrating risk assessment systems.


The project management theory says that depending on an organisation, an organisation breakdown structure (OBS) can be static and or dynamic (Kerzner, 2009). In a stable work place, the OBS is static, but for the project to work better there should be a matrix of workers from various organisations and sections of organisations. The ideal OBS is one that can use a matrix of line management and project management (Kerzner, 2009). For instance, existing
or supporting stakeholders and their organisations (such as the management team in the Kuwait Oil Corporation) can provide the line management duties and deal with the officialdom that comes with such jobs. To illustrate this issue, a typical OBS of a section on the KGOC oil and gas facility could have many layers of management. The highest position could be meant for the chief executive of the facility; at OBS level 2, the management level belongs to specialists. OBS level 3 operatives have direct supervision from gang leaders and plant operators. Apart from the PESTLE risk typology, the facilities are subject to possible risks through other means such as the implementation process. For example, the highest level of the official position carries the weight of the country as well as of the leadership. When one considers the issues of governance within the firms of a company, one finds that government representatives are also key players affecting operations of the government. While technical risk assessment operates at a certain level, decisions trickle down – in a top-down trend – to the general implementers.

The importance of the management structure in integrated risk assessment is that it creates the official structure through which the information, data and systems have to be implemented. Apart from the authority, the resource allocation matrix (RAM) would have to be implemented in the same pattern as the OBS. There are a lot of challenges to the KGOC because of the officialdom existing in a quasi-government institution trying to attract foreign investment, but lacking the sharpness in terms of management structures, hence reducing the propensity to efficiently manage the decisions. The other factor that emanates from the OBS is the social and cultural perspective of risk from the companies contracted to work on the facilities and the workforce employed directly by the KGOC.

This means that the organisational breakdown structure is a crucial element in the decision making processes that support the integration of risk assessment systems of oil and gas facilities. If the decisions are to be made in the “project environment form” there could be “speedy” decisions in the organisation, but the status quo shows that decisions need backing from central management of the KGOC.
4.4 Nature and Structure of Oil and Gas Processing Plants and their Impact on Risk Assessment

Generally, the processing facilities in the oil and gas industry are technically complex, involving the integration of many different technical disciplines on the basis of a large codified body of knowledge. The technical complexity is perhaps best illustrated by the high level of technical availability (typically over 95%) during the lifetime of the facility (typically 20–25 years). This places high demands on the quality of the technical development and implementation process to achieve the required functionality (Berends, 2007). Because of their size and technical complexity such facilities experience the following major risk typologies:

(a) The large investment yields no revenue until after implementation;

(b) The facility is indivisible with limited possibilities to reduce exposure through breaking up the scope of work;

(c) Transferring the facility to another location is generally not feasible with limited options for redeployment of equipment;

(d) Development and implementation times are long, typically 2–3 years and 3–5 years, respectively (Berends, 2007; Miller and Lessard, 2000).

The Kuwait industry is still developing some of the facilities while expanding capacity. This means that risks are high because of the transformational nature of the industry. For local and international stakeholders the risks range from political to technical. There are many stakeholders, some of whom fall under the following categories:

(a) The owner of the facility (and its shareholders), lenders, export credit agencies, insurers, etc;

(b) Contractors (licensors, engineering contractors, construction contractors, suppliers of equipment and materials, etc.);

(c) Authorities (governmental as well as local), local communities, non-governmental organisations;

(d) Customers and feedstock suppliers.
All stakeholders require competence to cope with risks and turbulence, and these become manageable through the design of strategic systems, the infusion of governability, the transformation of institutions, the design of financial arrangements and the building of owner–contractor relationships (Miller and Lessard, 2000).

This means that the nature of the facility and how it has been developed plays a crucial role in the integration of risks that an organisation would face. If the facility is under development, the contractual agreements would pose a crucial source of risk, especially due to high uncertainties in oil exploration and extraction, and the contractual agreements that go with oil and gas projects (Osmundsen et al., 2008). If the facility is under operation, the risks tend to emanate from the potential hazardous nature of the products in question: oil and gas.

4.5 Integrated Risk Management in Theory
Apart from the cyclical nature of the risk assessment process, the level of integration depends on many factors. Integration means the making up or composition of a whole by adding together or combining the separate parts or elements. Combination into an integral whole when applied to risk, or integrated risk assessment, can be defined as “a process that combines risks from multiple sources, stressors, and routes of exposure for humans, biota and ecological resources in one assessment (Assmuth and Hilden, 2008). It means that a business takes a holistic continuum of the risks from those that could be said to be generally strategic to those risks that can be said to be detailed and technical in nature. There is no agreed level of integration in the management of risks because the level of integration is largely dependent on the availability of information (Grundke, 2010).

Practically, an organisation has the opportunity to integrate the risk assessment systems at various stages of their production by ensuring that the risk assessment is constantly reviewed in terms of its impact on other sections of the organisation. Figure 4-2 demonstrates the cyclical nature of risks to a business of this nature. To manage the risks, there is a need for an integrated approach.
4.6 Integrating the Risks Associated with the Hydrocarbon Industry: an International Perspective

Berends (2007) stated that the hydrocarbon industry in any country struggles with location problems as well as coordination of projects due to location. For Kuwait oil and gas facilities, there are practical risks associated with development. When the facilities are commissioned, other sets of practical risks set in, especially those pertaining to functionality. The political environment of Kuwait means that a lack of investment in oil and gas has resulted in the low capacity of the industry. While demand for oil has focused on an increase (Oil Gas Journal, 1980–2005) the rate of expansion has not been matched as far as Kuwait is concerned. For example, in the Asia Pacific region, high levels of economic growth and demographic factors (the region accounts for the largest population growth in the world) will continue to drive demand for additional refinery capacity. Globally, the EIA projects an annual growth of 1.9% during the next 20 years (EIA, 2005). In fact, the global consumption of hydrocarbon products is projected to increase in the next 20 years. This means that there is a high demand for the infrastructure that is necessary to meet this demand. Half of this increase pertains to electric power generation, replacing oil and coal-fired plants that are more carbon intensive.
than natural gas. The other half relates to residential, commercial and transport uses. Liquefied Natural Gas (LNG) will become increasingly important (Berends, 2007). During the last decade, new gas processing facilities have grown in size due to technological improvements. The increased economies of scale have resulted in a fall in the specific capital cost of processing facilities (Cogan, 2005). Many natural gas resources are located either a long distance from end users or they lack a pipeline infrastructure (Robertson, 2005). For Kuwait, however, this is not the case because the facilities are yet to be fully developed.

To meet the challenges of investing in huge capital facilities such as the oil and gas facilities, risks must be viewed from varying angles (Esty, 2004). Unless investors are convinced that the Kuwait economy can manage the influx of investment, the cost of capital would be astronomical. This means that flexibility by the KGOC management is needed at all project levels (Olsson, 2006), especially in terms of behavioural competencies such as culturally acceptable management strategies.

At the international level, the management of risk tends to be regulated from the operational side of the business while the strategic level is left to organisations to deal with. This means that the international approach is prescriptive of the results it needs, but does not state how such results would be arrived at.

**4.6.1 Occupational Health and Safety Risk Management for the Industry**

The meaning of risk in the industry in international terms borders on occupational health and safety including the processes of assessing it. Apart from the mechanics of risk assessment related to health and safety, it would be possible to institute the hydrocarbon industry reviews of risks that could be encountered in the work place, for instance, the political and economic factors as well as social risk typology, as shown in Figure 4-3.
Practically, the HSE (2006) produced a web friendly five step implementation of risk assessment. However, the application of such a process would have to take place in the workplace environment, hence ensuring that the workforce is safe. It can also be referred to as occupational health. The “Occupational health and safety (OHS) regime contains three different collaborating arenas or structures within the company: (1) a working environment or safety committee with balanced representation from the parties, (2) safety representatives elected by the employees and (3) in-house or external health and safety experts employed by and representing the management (Hovden et al., 2008). Figure 4-3 shows the integration of these four themes within occupational health and safety, namely “safety representation”, internal control, use of experts and using professional knowledge to assess the workplace.

The main justification for integrating risk assessment systems is to improve workers’ psychosocial and organisational development, productivity and efficiency gains (including injury prevention) and the fulfilment of ethical and legal imperatives (Hovden et al., 2008). For an
organisation to implement good occupational health programs it must have a good infrastructure that helps to ensure that expectations are met; through this structure, management provides the standards, documentation and resources for responsible management of company operations (Hansen, 2006).

4.6.2 Technical Requirements for Health and Safety in the Oil and Gas Industry
Van den Hove et al. (2002) emphasised that, depending on the strategy that an oil organisation takes, it might overly expose the company to unnecessary risks, meaning that there is a dilemma for oil corporations to prioritise their business interests. Technically though, the British Standard Occupational Health and Safety Assessment Series 18001:2007 requires a careful planned policy, planned implementation, monitoring and review on a continuous basis, as shown in Figure 4-4.

![OH&S management system model for this OHSAS Standard](source: BS OHSAS 18001:2007)

On the contrary, BP did not implement a structured approach as required by the standard. As a result, Greenhouse (2009) reported that “the Occupational Safety and Health Administration announced the largest fine in its history, $87 million in penalties against the
oil giant BP for failing to correct safety problems identified after a 2005 explosion that killed 15 workers at its Texas City, Tex. Refinery”.

4.7 Typical Risks Inherent in the Oil and Gas Industry of Kuwait

Patin (2010) summarised most of the risks inherent in the oil and gas industry, especially the off-show stations, as is the case in Kuwait. Accidents inevitably accompany offshore development. They are the sources of environmental pollution at all stages of oil and gas production. The causes, scale and severity of the accidents’ consequences are extremely variable. They depend on a concrete combination of many natural, technical and technological factors. To a certain extent, each accidental situation develops in accordance with its unique scenario (Patin, 2010). The most typical causes of accidents include equipment failure, personnel mistakes and extreme natural impacts (seismic activity, ice fields, hurricanes and so on). Their main hazard is connected with the spills and blowouts of oil, gas and numerous other chemical substances and compounds. The environmental consequences of accidental episodes are especially severe, sometimes dramatic, when they happen near the shore, in shallow waters or in areas with slow water circulation.

(i) Drilling

Drilling accidents are usually associated with unexpected blowouts of liquid and gaseous hydrocarbons from the well as a result of encountering zones with abnormally high pressure. No other situations but tanker oil spills can compete with drilling accidents in frequency and severity (Patin, 2010).

(ii) Transportation

Oil extracted on the continental shelf accounts for a considerable part (probably at least 50%) of annual volumes of oil transported by tankers (the latter constitute over 1 billion tons). The main causes of tanker accidents that lead to large oil spills include running aground and into shore reefs, collisions with other vessels and fires and explosions of the cargo. According to official data, the amount of oil spilled during tanker accidents in 1989 and in 1990 were 114,000 and 45,000 tons, respectively (Patin, 2010).

(iii) Storage

Underwater reservoirs for storing liquid hydrocarbons (oil, oil-water mixtures and gas condensate) are a necessary element of many oil and gas developments. They are often used
when tankers instead of pipelines are the main means of hydrocarbon transportation. Underwater storage tanks with capacities of up to 50,000 m$^3$ are either built near the platform foundations or are anchored in a semi-submerged position in the area of developments and near the onshore terminals (Patin, 2010).

(iv) Pipelines

Complex and extensive systems of underwater pipelines have a total length of thousands of kilometres. They carry oil, gas, condensate and their mixtures. These pipelines are among the main factors of environmental risk during offshore oil developments, along with tanker transportation and drilling operations. The causes of pipeline damage can differ greatly. They range from material defects and pipe corrosion to ground erosion, tectonic movements on the bottom and encountering ship anchors and bottom trawls (Patin, 2010).

4.7.1 Legal and Management Support for Health and Safety

Duijm et al. (2008) reasoned that the present status of industrial HSE management in a number of EU member countries focus on the integration of health, safety and the environment in single management systems; such is not the case with the Kuwaiti industry in that there are still elements of rudimentary operations. Even though operations tend to be based on a multitude of legal requirements under existing legislation, there are more factors, such as religious responsibility for the workforce, that play a more important role than the legal requirements. However, Kuwait abides by the regulations that attract not only fines, but also possible criminal proceedings (Greenhouse, 2008). This means that safety management requires that risk analyses be conducted. It is generally acknowledged that they are necessary. If the hazards and risks are not properly identified, it is not possible to manage them. Effective and efficient safety management necessitates risk prioritisation, which always entails some type of quantification both in terms of the likelihood of an accident and of its consequences (Duijm et al., 2008). Depending on the location, the hydrocarbon industry is prone to inhalatory and dermal exposures (Chen et al., 2008), making risk assessment crucial. Therefore, staffing levels should consider the use of the model shown in Figure 4-6 because of the complexity of the operations in the hydrocarbon industry.
4.8 The Current Risk Assessment Processes in Kuwait’s Hydrocarbon Industry

There are two basic approaches to quantitative and qualitative risk assessment; both have the same goal — to derive a probability distribution that describes the possible outcomes of an uncertain situation — and both generate valid results (Palisade Corporation, 2008). The first approach is simulation. This approach relies on the ability of the computer to do a great deal of work very quickly — solving a worksheet problem by repeatedly using a large number of possible combinations of input variable values (Palisade Corporation, 2008). The second approach is an analytical approach that requires the distributions for all uncertain variables in a model to be described mathematically (Palisade Corporation, 2008). Then the equations for these distributions are combined mathematically to derive another equation, which describes the distribution of possible outcomes (Palisade Corporation, 2008). Webb (2003) produced a generic template that could be used in the assessment process, as shown in Figure 4-6. Besides the process, there are techniques that can be used at any point in time. The question for the Kuwait industry is how well they can use such processes and techniques to integrate the risk management systems so that the mistakes of the other industries cannot be repeated, especially since the Kuwait industry has been identified as one which lacks infrastructure.

Figure 4-5: Model for managing operational staffing levels in chemical organizations (Source: Celik, 2010)
**Figure 4-6:** Risk assessment process (Source: Webb, 2003)
Using the template in Figure 4-6 allows focus on the most cost-efficient and assured strategy, including how to eliminate, retain and respond, seek to capitalise on opportunities, mitigate, avoid or transfer. The British Standard (BS) 31100 (2008) notes that in early phases of risk assessment processes it is “worth gathering more information about risks”. Due to the chemical processes of production, storage and transportation, there is use of people and machines and so there is an inherent potential risk. The first stage of this is to identify the level of tolerability, the “willingness to live with a risk so as to secure certain benefits and in the confidence that it is being properly controlled” (HSE, 1999). For instance, if there is a leakage, it should be kept as low as reasonably practicable (ALARP). This is conducted by ensuring all risks are mitigated to their lowest acceptable level, using the ‘ALARP’ concept as shown in Figure 4-7.

Figure 4-7: The ‘ALARP’ Concept (Adapted: HSE, 1999)

In conjunction with the ‘ALARP’ concept, risk factors need to be addressed including minimising the potential impact, the possibility of avoidance through management action, further investigation to mitigate the risk, the capability of transferees and any residual risks
that may remain. The decision can then be taken to avoid, seek, modify, transfer or retain the risk.

## 4.9 Corporate Responsibility and Risk Management in the Production Process: Avoiding BP’s Experiences

Corporate governance, in narrow terms, refers to the internal mechanisms in a firm that ensure profit maximization and protection of stakeholders in the firm. Thus, the very meaning of corporate governance draws a differentiation between owners and managers. To the owners, managers often pursue their personal goals, and to fulfil these goals, they may use the resources of the company inefficiently. Examples would include exorbitant remuneration paid to top management. However, serious problems could arise when several owners are at loggerheads with each other. Examples include cases where minority stakeholders lose out to majority shareholders due to the wrong exercise of power. Thus, according to Shleifer and Vishny (1997), corporate governance is basically aimed at assuring financiers that they will get a return for their investment. It is little wonder then that corporate governance involves issues between owners, managers and stakeholders and is therefore a complex issue in itself.

The basic aim of positive governance is to promote the contribution of firms to social, economic and environmental progress. Business ethics is mainly concerned with how a firm relates to the world outside (Johnson et al., 2008). It refers to the company’s internal ethics applied in the real world in real time by ensuring that key stakeholders’ interests are balanced with other factors such as profitability and business viability (ibid). In a broad sense, business ethics refers to when companies decide to voluntarily contribute to a better society and cleaner environment (The Commission of European Communities, 2002). However, business ethics is more than just investing in human resources, environment and positive social relationships.

A corporation may be considered a single business entity with the power to make decisions based on policies and take corresponding action. This is why corporations have an internal decision making structure distinct from the individuals who make up the organization. According to this concept, corporate sanctioned actions are those that have the approval of this structure and are in line with established corporate policies. By definition, it is right to assume that any action that is a violation of the policies laid down by this internal structure is therefore individual behaviour and not a reflection of corporate behaviour (Worthington et
al., 2009). Understanding this basic fact is important in a discussion of business ethics as opposed to individual ethics.

Business ethics and corporate governance that aims to ensure ethical practice of business date back to the nineteenth century. Neglecting business ethics can result in poor decision making for the firm (Wright and Goodwin, 2009).

Basically, a society may approve a company’s existence if the firm:

- Creates something of value for the society
- Does not harm the society or at least does more good than harm

In the past, a company could pollute local river bodies and still be considered beneficial to society. Today, rules and regulations may jeopardize the very survival of such companies. Many countries have laws that ensure the implementation of fair business ethics. For instance, US legislation makes use of imprisonment, sanctions and fines to punish fraudulent corporate activities, while in the UK, criminal penalties are not used as an explicit form of punishment when ethics are violated. Instead, the policy is to encourage positive behaviour. Thus, people and the communities they form do influence the way firms work. This influence may be exerted through public opinion, legislation, rules or political contacts. In fact, regulations guided by legal parameters are the ‘floor’ of corporate good behaviour because these laws are the manifestation of what the society will accept as ethical corporate conduct. However, there are difficulties in these regulations and parameters too.

For one thing, societies, like people, may enforce laws that necessitate unethical actions. This is particularly important in the case of companies that operate overseas or internationally. More importantly, accepted social standards may keep changing. Therefore, businesses have to change in response to these changing expectations. This presents firms with a dilemma. On the one hand, firms appreciate the presence of a level playing field, but firms also need flexibility and creativity to grow. That is why governments cannot agree on a binding hard law and there are various ‘soft laws’ that are put into practice. Business ethics also seem to change according to the country in which the company is operating (Frynas, 2006). An example would be Malaysia. The firms in this Islamic nation are concerned about the religious implications of their activities and business practices. In Argentina, companies have developed a peculiar social approach because of the economic crisis that took place in 2001.
Therefore, it is clear that social responsibility and business ethics mean very different things to different people and in different countries.

4.9.1 A Case Study: British Petroleum (BP)
Companies dealing with oil and gas have always been at the forefront of business ethics and corporate social responsibility. One reason is the fact that the negative impact of their operations is costly in terms of money and lives as well as natural resources. For instance, a major oil spill in the coral reefs can put an end to millions of years of life and growth. It also kills the natural environment in a stroke. Oil tanker accidents like the spill by Exxon Valdez and the hue and cry over human rights violation by BP in Nigeria are examples of how these companies attract widespread media coverage. Due to this, there is always huge pressure on these companies to build and present a clean image to the public at large.

Therefore, it is only natural that oil companies pay maximum lip service to the social responsibilities of the company regardless of the personal motives of their executives in framing policies. That is why most of these companies have stringent codes of conduct and practices of social reporting. This is not only true of companies in societies like Europe but is also true of those companies operating in more conservative societies. An example is Kuwait Petroleum. This also explains why they have embraced a number of initiatives, big and small, to bring about positive changes in the society.

According to the company’s Senior Advisor, Nicholson (2002), “a company’s primary responsibility is towards its shareholders, to its owners” and it must keep its obligations to the owners without losing sight of its social responsibilities. The boundaries of social responsibility have to encompass that which is practical. So, the company must not be considered a panacea for all ills. It has limited reach, limited resources and limited expertise. Most importantly, the boundaries of social responsibility are always changing. So, the company must not be judged by actions in the past. For instance, at one point in time, BP had taken up the social responsibility for entire communities in Iran. At that time, social responsibility was almost equivalent to philanthropy. However, in recent times, social responsibility is more concerned with creating value to shareholders as well as the community at large.

Thus, it is obvious that the corporate governing body is aware of its ethical responsibilities to its workers and the society at large. The company even has a safety, ethics and environment
assurance committee, which is in charge of monitoring non-financial issues. The board consists of ten non-executive directors and their major responsibility is mitigation of risk.

Actions taken by BP to mitigate risk:

- In 2007, the company invested more than $6 billion to minimize risks of major accidents;
- BP took steps to improve the skills of executive staff, which in turn, bettered safety practices at plant level;
- The company also drew up a six-point plan to address issues involving safety management;
- A new operation management systems (OMS) was implemented to strengthen safety systems and environmental management systems.

As a result of several initiatives like these, the company has been successful in making significant progress in the area of safety. For example:

- Refineries in the US have been taking action to implement recommendations related to safety, although this will take time;
- Outstanding items regarding process hazard analysis, audits etc, have been produced.
- A number of extensive programs have been undertaken that help enhance process safety competency.

In order to ensure complete staff safety, the company also identified potential problems that could jeopardize safety. Some areas of concern included:

- Overtime hours;
- Management of overdue action items;
- Lack of clarity in the responsibilities of safety support staff.

Thus, the effort of the corporation seems to be directed towards changing the existing culture of the company by addressing rigorous safety improvement requirements. To achieve this goal, BP has been making changes to its bureaucracy to ensure simplicity and reduce complexity. Although a significant amount of work is left to be done, the corporate social
The report concluded that the company had made significant inroads into the area of tackling maximum safety.

- The company also explored the possibility of harnessing hydrogen for fuel.
- A major project was undertaken to build a commercial bioethanol plant.
- The company is also supporting research in the Biosciences institute in the US by providing more than $500 million in 10 years.
- The company also launched its ‘target-neutral’ programme that allowed it to offset approximately 53,000 tonnes of carbon-dioxide emissions. In short, BP envisages a low-carbon future.

The company also has plans to invest money in renewable sources of energy. Major programmes include building hydrogen power plants and the promotion of bioethanol plants. This will help the company achieve higher standards for developing sustainable bio-fuels. Another significant step towards taking responsibility for the environment was the setting up of the REC (Regional Ethics Committee). This committee was established in many parts of the world and its objective is to focus on ethical issues and make sure that the company adopted a consistent approach. It also makes sure that the company receives the necessary guidance for the application of these standards wherever they operate.

BP has positioned itself in the forefront of the clean environment campaign by increasing operations in fossil fuels. BP is also taking a high profile stand on renewable energy to combat changing climatic patterns in Europe.

Thus, the key concerns addressed by British Petroleum in its report have been:

1. Safety
2. Environment

BP is one of the largest companies in the field of production and distribution of energy. That is why BP finds itself at the centre of the safety and climate change debate. Although it has received flak for some of the disaster management systems in the company, it has also received much praise for its performance in the area of environment.
That there is much pressure on energy companies to ensure transparency and responsibility as far as their policies and practices to ensure a safe environment are concerned cannot be doubted. As a response to this, BP has crafted a strong vision to ensure that the environment is not damaged by its activity. This is a challenge that has made BP innovate and find new ways to manage the impact of their activities at local, regional and global levels. That is why BP has taken up a multi-pronged approach to prevent damage to the environment, including regulating water usage, use of low carbon emission products, biofuels and regulating waste emissions. It has also taken a strong stand on safety. However, how much of this is translating into real actions at plant level?

4.9.2 Actual Impact of Corporate Governance on Safety in BP
When 15 workers died in an explosion in a refinery in Texas City, it was found that BP was not fulfilling its undertaking to improve safety by improving equipment. The lawyers of the victims in the explosion produced a report that showed that a number of life-threatening and serious inadequacies existed in BP’s compliance with the terms imposed on them by US regulatory authorities. According to lawyer, Mike Sawyer, “violations of federal law create continuing, unreasonable risk” and can continue to cause major explosions and greater loss of life in the future.

However, upon further investigation, charges of noncompliance were dropped in all cases but one. BP pleaded guilty to violating the Clean Air Act and had to pay a $50 million fine for the same. Even so, the jury is out on whether the investigations were conducted appropriately. In one case, safety audits were conducted mostly by the personnel of BP itself. There was no verification by an independent body. Interestingly, BP agreed to take responsibility for the blast and it has spent more than $1 billion to upgrade and improve its facilities.

Other recent reports suggest that BP may have been slapped with fines for (OSHA, 2010) “wilful safety breaches” in its Ohio refinery. The fine could be up to $3 million. It might be worth noting that this fine came just four months after the company was fined for its activities in Texas.
4.10 Summary
The risks inherent in the oil and gas industry of any national and international market are interwoven in the business structure of the industry as well as the way an organisation functions, from its internal operations to external strategies. Depending on how quickly they can respond to incidents, there is a high chance that preparedness, integration and training play an important role in how an industry can respond. There are legal and cultural reasons why an industry in its infancy, like that of Kuwait, needs an integrated approach to the application of risk assessment systems so that those incidents that could destroy the industry can be avoided. History indicates that major accidents happen in industries where companies work in isolation, without testing mechanical integrity and risks associated with operations or sharing the information amongst players and that these factors have resulted in fatalities at oil facilities. In the case of the BP incidents, Cable (2010) succinctly concluded that “there was a complex set of “underlying reasons for the behaviours and actions during the explosion incident”; he emphasised that workers and supervisors caused the accident by deviating from procedures. The BP investigation team asserted that one key mistake was the failure of BP personnel “to establish heavy raffinate rundown to tankage, while continuing to feed and heat the tower.” And that “safety system deficiencies created a workplace ripe for human error to occur.” There are compelling reasons to integrate risk assessment systems, starting from corporate social responsibility as well as ensuring that incidents do not hit the profitability of an organization as was the case with BP.

This chapter has also shown that no organisation can insulate itself from the legal repercussions related to breaches of occupational health and safety laws of a country, as explained by Grier and Sidnell (2010). Before an incident takes place, companies operate within the occupational health and safety law to the point at which any breach of law would cost more than to work within the law, as was found out by BP after the Gulf of Mexico incident of 2010. It is in the nature of the oil and gas industry to produce contaminants, some of which are well known while others may not be known. For example, Cowie et al. (2011) explained how Saudi Aramco dealt with nuclear contamination within their oil processing systems. Their response meant that they were able to isolate the risk and deal with it adequately. However, responding to inherent risks in the oil and gas business needs an organisational structure that can allow various professionals to integrate the business requirements as well as the occupational health and safety needs of the workforce. There are international standards such as the ISO 18001 that could act as a guide to the implementation
process. However, particular attention needs to be paid to the technical procedures as well as legal provisions so that implementation of risk assessment can be as transparent as possible.

Robb and Miller (2012) argued that standards are there for any organisation to use; however, they need to be implemented by people within the organisation. It is, therefore, the task of the strategic managers to ensure that safety standards can be implemented in line with international standards. Additionally, managers have to be more specific with the allocation of resources as well as the recognition of human needs in the workplace.

Oil and Gas exploration and production activities are carried out in hazardous environments in many parts of the world. Recent events in the Gulf of Mexico highlight those risks and underline the importance of considering human factors during facility design (Grier and Sidnell, 2010). Some cultures believe that health and safety standards are sufficient if they ensure that workers can perform their duties; however, the principles of occupational health state that workers need to be heavily involved in the planning and execution of the health and safety plans within their organisation (section 4.6) so that they can take ownership of the initiatives.
5. CHAPTER FIVE: RESEARCH PARADIGM, METHODOLOGY AND METHODS

5.1 Introduction
By definition, a research is “a careful study of a subject, especially in order to discover new facts or information about it” (Oxford University Press, 2011). This means that investigation into any issue would have to be systematic and organised and auditable so that a procedure could be repeated (Neuman, 2006). For any researcher to commence their work on a technical note, they need to establish their main research philosophy, their research paradigm and their research methodology so that they can determine the best research methods to use. By research methodology we mean the process of or system for doing the research; it should be based on a personally designed method of investigation that can be undertaken so that a person can learn, gain an understanding of or approve or disapprove of a concept (Berkhardt, 2002). Regardless of the research or the field of study, any research needs to follow tried and tested strategies that are based on underlying philosophical assumptions, explained Fellows and Liu (2008); this implies that even this research would require a clear philosophical methodology that can be used as a guide.

This chapter, therefore, examines the research paradigm, research philosophy and the methodology that can be used for investigating the impact of social-cultural values on health and safety management in oil refineries in Kuwait. The chapter examines the philosophy and the paradigm that can be used, then it states the methodology that has been adopted, including the justification for the choice of methods.

5.2 Research Philosophy and Paradigms in General
The Oxford Advanced Learner’s dictionary defines philosophy as “a particular set or system of beliefs resulting from the search for knowledge about life and the universe” or “a set of beliefs or an attitude to life that guides somebody's behaviour” (2011). These two definitions apply to the current research because, much as we seek the information relating to the values in health and safety management, the research process has the capacity to be affected by the personal beliefs and attitudes of the researcher. In other words, for the researcher to think clearly about the questions or to provide the interpretations about their ideas, they need to think clearly about the factors under consideration as well as the outcome of the research,
explained Ruona (2000). If one has a set of beliefs about a situation, it means that one has set a framework which can be used to guide research; within that framework, one can design the research process, including the way to deal with any constraints (Easterby-Smith et al., 2003). Saunders et al. (2009, p107) summarised the meaning of research philosophies in a succinct manner when they stated that the “over-arching term relates to the development of knowledge and the nature of that knowledge”.

On the other hand, the term paradigm means “a model of something, or a very clear and typical example of something” (Cambridge University Press, 2013). To any person, a paradigm is their view of a given situation they wish to deal with, or the research they need to undertake, based on their beliefs (Guba and Lincoln, 1994). The perception that a person has about an issue may not only be philosophical, but also paradigmatic in that the person may hypothesise about the issue in order to reach a view on it, even though their view may not be correct (Henning et al., 2004). Many research authors look at the paradigm as a method of understanding a social phenomenon. Once the phenomenon has been understood, it can easily be explained (Saunders et al., 2009). It is, therefore, important that both the philosophical basis upon which the research is built needs to be complimented with the view about the phenomenon that is being researched, hence creating a situation where the philosophy tallies with the assumptions that have been made by the researcher.

When you consider the current problems associated with health and safety in oil and gas industries around the world, you will realise that, as much as the technical faults cause accidents, there are human factors that are influenced by the social-cultural and sometimes the religious inclination of the workforce. This implies that the perception of risk varies from person to person regardless of their training and technical knowhow. Research of this nature requires a combination of technical, social and cultural philosophical stances in order to come up with a good approach for research. In addition, the research paradigm equally has to consider the basic assumptions that typify the oil and gas industry in Kuwait where this research has been conducted, and the area where the research will be applied, in other words, the “lens” that the researcher takes when considering all the factors necessary for executing the research (Fellows and Liu, 2008). According to Saunders et al. (2009) there are four main philosophies that can be used to explain the development of knowledge: (i) pragmatism, (ii) interpretivism; (iii) realism and (iv) positivism. The main focus, therefore, is to look at how
any researcher perceives the relationship between knowledge and the process of developing it (ibid). This means that the ontological stance one takes would have to deal with the perception of the nature of the existence of the phenomenon being researched (Oxford University Press, 2011). Similarly the epistemological – [“the part of philosophy that deals with knowledge” (ibid)] stance that one takes tends to be influenced by the underlying philosophy that has been adopted. Hence, any decisions about data collection methods or data analysis would be influenced by the way the philosophies have been set from the outset of the research (Saunders et al., 2009).

Another important factor is the axiological stance that a researcher takes. According to the Encyclopaedia Britannica (2013) the term “axiology” comes from the Greek word ‘axios’ which means “worthy” and the other word, ‘logos’, means “science”. Axiology is also called the “Theory of Value” because it is the “philosophical study of goodness, or value, in the widest sense of these terms. Its significance lies (1) in the considerable expansion that it has given to the meaning of the term value and (2) in the unification that it has provided for the study of a variety of questions—economic, moral, aesthetic, and even logical—that had often been considered in relative isolation”. The implication of axiology for any researcher relates to major considerations regarding the value of what philosophy to take, based on his/her view of the world. It is therefore important that we consider the philosophies based on the researcher’s world view, the ontological questions, epistemological factors as well as the axiological factors before we decide on the best methodology to adopt as well as the ideal methods necessary for this research.

5.2.1 Pragmatism
According to Saunders et al. (2009) pragmatism takes a stance that the most important determinant of the epistemology, ontology and axiology that one can adopt is the research question. This means that the research question dictates what answers are needed and that will dictate the process of gaining an understanding in terms of knowledge, the value of the knowledge and the process of the research. Creswell (2007, p23) explained that pragmatism does not involve a single philosophy or a single reality, it involves any one that can facilitate the process of reaching the action points that are needed for the answers to be obtained. This means that the researcher could rely on objectivism – where the researcher presumes that “social entities exist in reality external to social actors” (Saunders et al. 2009, p110) – or on
subjectivism which presumes that “social phenomena are created from the perceptions and consequent actions of social actors” (ibid, p111). If the researcher takes the objectivism approach, he/she believes that decisions are made based on objectivity, and that means that every person who is asked the same question may come up with similar answers because the situation is objective (Creswell, 2007). On the contrary, the subjectivism stance means that the answers the researcher gets emanate from social interactions, perceptions and the personality of the people being asked, and that nothing can be certain until one gains an understanding from the subjective person (Saunders et al., 2009). The most important issue here is that the pragmatist can take any approach deemed necessary in order to arrive at the answer, and that is why this philosophy is appealing to many people since it frees the researcher to deal with each situation as it arises.

5.2.2 Interpretivism
When a researcher takes the stance of interpretivism, he/she needs to understand that humans are different social entities that interact as actors in various ways; therefore, conducting research amongst people requires more planning, reasoning and interactions with social actors (Saunders et al., 2009). There are many ways of interacting with people so as to get information from them and their experiences (Creswell, 2007). Therefore, the planning of the research and the way the data can be collected need to take into account all these factors. Fellows and Liu (2008, p18) felt that the interpretive paradigm for research is very useful in terms of the way research is conducted because it makes sure that the management of the people involved is taken into consideration. For instance, factors such as the social context, their culture and their way of life have to be considered carefully.

5.2.3 Realism
Saunders et al. (2009, p114) explained that realism assumes that there is a reality quite independent of the mind. It believes in reality not simply in ideas such that the knowledge or assumptions can be proven if the data underpinning the assumptions can be collected, tested and verified. There are two main types of realism: (i) direct realism which basically means that “what you see is what you get” and “what we experience through our senses portrays the world accurately” and (ii) critical realism. Critical realists argue that what we experience are sensations, the images of things in the real world, not the things directly; therefore, we need to investigate more and see the way our senses deceive us (ibid, p115). Sometimes there is
not enough information for a realist, however, the paradigm is crucial in the way one can see the data and be able to interpret it so that one can find a solution to a given research problem.

5.2.4 Positivism
According to Fellows and Liu (2008, p17), positivism focuses on the argument that “there are observable facts which can be observed and measured by an observer, who remains uninfluenced by the observation and measurement”. In other words, the researcher is objective enough only to observe, collect and rationally decide based on the empirical evidence presented to them. The observable social reality can be measured and the end product of such research can be law-like generalisations similar to those produced by the physical and natural scientists” (Saunders et al., 2009, p113). Therefore, when researchers use a positivist approach they are expected to prove the theories that they may have developed prior to the collection of data. However, it has been observed over the years that positivism is not realistic in many ways (Fellows and Liu, 2008) because it assumes that there will be no biases from the data collector and or analyst. In reality there is a chance that people will be affected when they are collecting data or doing something that they may not have been intending to do.

All these philosophical paradigms work well if the researcher has taken a step in creating a line of reasoning for their work. For instance, if the reasoning is deductive or inductive, he/she can develop a way of collecting the data that can be used for testing the theories at the right time. It is therefore important to consider the approaches to reasoning, as explained in section 5.3.

5.3 Approaches to Reasoning about the Research
There are two main forms of reasoning that a researcher can use to arrive at a conclusive end of their research. According to Bryman and Bell (2011), a researcher can use deductive or inductive reasoning.
5.3.1 Deductive Reasoning

This is a traditional way of carrying out research and has been used by scientific researchers over the years because it commences with assumptions or hypotheses, questions or developing a theory prior to collecting any data (Gill and Johnson, 2010). Figure 5-1 illustrates the process of deductive reasoning where the researcher commences the work with a research issue. In the case of this research, the issues are to do with the social-cultural influences on the health and safety operations of the oil and gas purification plants in Kuwait. Secondly, a theory is developed; in this case, it involves using literature to arrive at the theory that there could be an influence from social-cultural values on an individual as far as health and safety risks are concerned.

Thirdly, the researcher needs to develop testing mechanisms by making sure they state the research questions or hypotheses and generate variables that are measurable (Fellows and Liu, 2008) so that there is a way of testing the theory. This also includes the establishment of a data collection system that is robust enough to make sure the data is valid and reliable (ibid).

Fourthly, the researcher needs to observe and test the data, and then produce the results that can be used to prove, disprove, confirm or dispel the research theory that was formed initially.
If the researcher adopts deductive reasoning, it means that he/she will also be influenced by his/her way of perceiving knowledge (epistemology), the way he/she perceives the process of understanding that knowledge (ontology) and the value system created (axiology). Hence it is prudent that whatever paradigm one adopts, the researcher needs to be sure that he/she has arrived at the best methodology while clearly stating the philosophical standing guiding the research issues.

5.3.2 Inductive Reasoning
Inductive reasoning is the exact opposite of deductive reasoning because the researcher sets out without any prior arranged reason for the research; rather, they observe the pattern of data and situations in an open manner (Blaikie, 2010). Thereafter, they develop knowledge based on the observations, so that they can then develop a theory or create meaning (Trochim, 2000). Figure 5-2 shows that the researcher starts observing the empirical world but not only that, he/she can observe even the non-empirical world or data. Secondly, the researcher can see the pattern within the data being observed and create building blocks for the potential theory that he/she can build. Thirdly, the researcher arrives at a pattern and that allows for creation of a theory which can be confirmed in stage four. By taking an inductive approach,
the researcher is within his/her research area, which makes it more specific (Gill and Johnson, 2010; Saunders et al., 2009).

![Diagram of inductive reasoning process]

**Figure 5-2:** Illustration of the inductive reasoning in research (Adapted: Gill and Johnson, 2010)

Inductive reasoning is extremely important for research on social-cultural values and how they affect health and safety risks in oil refineries. This is because, by observing the pattern of incidents, there is a possibility that one can create theories about the main causes of accidents and how they are resolved. It is therefore important that this reasoning is allowed as it adds value to the process of getting data.

5.3.3 Methodological Considerations
Research should be methodical because there is some form of investigative, scientific and critical value in evaluation (ibid). In other words, the research methodology stands as “the rationale for the chosen system of research in a dissertation which is to develop a concept and through process observation, formulate a qualitative conclusion” (Holt, 1997). The underlying philosophies and paradigms that have been discussed are essential in creating a
research strategy that has been used herein. Therefore, the research strategy adopted has also been designed with the philosophy in mind. Research strategy means “the way in which the research objectives can be questioned”, and they are two main strategies: (i) qualitative research strategy and (ii) quantitative research strategy (Naoum, 2006). The choice of which strategy to use depends on many factors, but key are (i) the type of research and (ii) the availability of the information required to carry out successful research (ibid). Flick (1998) reasoned that an ideal research methodology at any point in time should be viewed from the point of view of its appropriateness. When people design a research methodology, they design a process that will be taken in totality, from gathering secondary data to gathering primary data, analysis and presentation of results. The overall approach may be centered on qualitative or quantitative research as explained below.

5.4 Quantitative Research Methodology
Quantitative research is ‘objective’ in nature and is defined as an inquiry into a social or human problem, based on testing a hypothesis or a theory composed of variables, measured with numbers, or analysed with statistical procedures in order to determine whether the hypothesis or theory hold true (Naoum, 2006). A quantitative research method is therefore not abstract; it is hard and reliable because it can be measured with tangible, countable features (ibid). Quantitative research generates statistics through the use of large-scale survey research, using methods such as questionnaires or structured interviews (Dawson, 2002). If a market researcher has stopped you on the streets, or you have filled in a questionnaire which has arrived through the post, this falls under the umbrella of quantitative research (ibid). This type of research reaches many more people, but the contact with those people is much more brief than it is in qualitative research (Dawson, 2002). Fellows and Lui (2003) say that, in effect, quantitative strategy involves making measurements by collecting data. For this research, it is not possible to rule out this strategy because of the quantitative nature of data from the oil refinery which drives probabilistic risk analysis.
5.5 Qualitative Research Methodology

Naoum (2006) stated that “qualitative research is subjective in nature and that it emphasises meanings, experiences and descriptions”. This research method can be split into two categories.

1. Exploratory: used when you have a limited amount of knowledge about a topic. Research can explore the topic with a combination of various methods such as interviews, observations and the like to make sure the information makes sense (ibid).

2. Attitudinal: a subjective way to evaluate the opinion or view of a person about a topic (ibid).

In summary, the qualitative approach can be said to rely heavily on the attitude of the researcher, and the measurement is based on opinions, views and perceptions (Naoum, 2006). There is a need for a researcher to get ‘rich and deep’ data to make such a research method effective.

5.6 Quantitative and or Qualitative Research Approach

Metzler and Davis (2002) stated that “traditionally researchers have been solely dependent upon one or other of the categories”. However, “there is a consistent development amongst contemporary commentators, who are suggesting that a combination of both, qualitative and quantitative techniques is required to achieve distinctive research methodologies” (Kelle, 2001). Using both quantitative and qualitative techniques to investigate a topic can make for a stronger outcome for the researcher because the numbers can provide data while the qualitative approach can explain the logic behind the numbers.

5.7 Alternative Research Methodologies and Justification of Final Choice

5.7.1 Ethnography
Silverman (2000) stated that “ethnography research is in essence observational research which emphasises on demonstrating the relationship between forms of heterogeneous action rather than trying to identify a culture as a whole”. It is a study of people, especially their societies and customs. Here, a researcher uses socially acquired and shared knowledge to understand the observed patterns of human activity (Hussey and Hussey, 1997). Ethnographic
studies are carried out to satisfy three simultaneous requirements associated with human activities (Silverman, 2000):

1. The need for an empirical approach, dictated by the fact that the phenomena studied cannot be deduced but require empirical observation;
2. The need to remain open to elements that cannot be codified at the time of study;
3. A concern for grounding in the phenomena observed in the field.

Ethnography can be integrative, where sequences of ethnographic observations are integrated by relating them to a cultural whole, a global reference which encompasses these observations and through which the different data throw light on each other. Or it can attain a narrative integration, an attentive reading through ethnographers field notes (Silverman, 2000).

5.7.2 Grounded Theory
According to Saunders et al. (2009, p148) grounded theory is a qualitative research method that embarks on gathering the data without any form of preconceived theory. The data that is collected in a systematic way can then form the basis for developing a theory, meaning that the theory is grounded in the data that has been collected systematically (University of Hertforshire, 2013). The approach of developing grounded theory is mainly inductive because the researcher starts from nowhere but the data is the main leading factor whereby the meaning within the data is determined and any relationships are deduced from the data. Because grounded theory is inductive in nature, it provides greater flexibility within the research for the creation of a theory from the data, or for the development of comprehensive theories that can be flexible as opposed to being rigid (Saunders et al., 2009). The success of the grounded theory depends on the planning of the data gathering process as well as the objectivity of the researchers who manipulate and analyse the data by making sure that all processes are as formal as possible with tested means of data collection and analysis (ibid).

5.7.3 Phenomenology
Creswell (2007) explained that people experience things and if they are asked about those experiences they are able to explain them in accordance with their experience. Phenomenology, therefore, implies a research that is conducted by gathering information
from those who have experienced a phenomenon. This would be an ideal strategy if it were used for gathering information from those with experience of incidents within the oil and gas industry, although it may not be easy for those who have had negative experiences or have been physically affected or injured by accidents because of the memories that questions about their experiences could cause. As a strategy, it is extremely good for social and cultural related studies such as this one, but it has to be planned and care must be taken with regards to the ethical issues that may arise as and when a researcher straddles the delicate issue of experience with victims of accidents.

5.7.4 Questionnaire Survey and Justification for the Choice of a Questionnaire and Interview Survey
A survey design provides a quantitative or numeric description of some fraction of the population - the sample - through the data collection process of asking questions of people (Creswell, 1994). This data collection enables a researcher to generalise the findings from a sample of responses to a population (ibid). Essentially, “the survey studies the sample not in its own right but as a means of understanding the population which it is drawn” (Robson, 1997). Studying the population would be too expensive because it is not possible to ask every person involved in what the researcher is looking for. Survey research may take the form of a questionnaire, administered either by interview or as a respondent completed form (ibid). The rule of thumb for deciding the most beneficial survey is the depth and quality of data needed, as opposed to having a large number of responses with vague information (ibid). If the data collection procedure for the survey is properly designed, data processing and analysis become easy (Clark and Bourque, 1992) and can be done qualitatively or quantitatively with minimal complexity and ambiguity (ibid).

In descriptive surveys, the researcher is concerned with addressing particular characteristics of a specific population of subjects, either at a fixed point in time or at varying times for comparative purposes. Hence, questionnaire design determines the required information and can be complemented by interviews which, according to the Open University (1991), offer the opportunity for the researcher to probe deeply to uncover new clues, open up new dimensions to a problem and secure vivid, accurate inclusive accounts based on personal experience. Interviews can be initiated, adapted and presented by the researcher in a
systematic manner and clarity and participation can be encouraged. However, Kumar (1999) noted advantages in using questionnaires, as stated below.

1. Less expensive
2. Greater anonymity
3. Capable of being standardised

Demerits of questionnaires, according to Kumar (ibid) are:

1. Limited application to those who can read and write
2. Low response rates
3. Self-selecting bias attitudes of respondents
4. Lack of opportunity to clarify issues
5. Spontaneous responses are not allowed for
6. Response to the question may be influenced by the response to other questions
7. Respondents will not necessarily report their beliefs

5.7.5 Choice Criteria for both Interviews and Questionnaires
The best way to collect data will be to use interviews as well as the questionnaire. Selection of the method to use, in Kumar's (1999) view, is based on the following factors:

1. The nature of the investigation - if the people were reluctant to talk about the issues, then a questionnaire would be good to ensure anonymity. This is helpful because the modeling of risks in the oil industry is complex so there will be people that would not wish to speak.

2. The geographical distribution of the study population is scattered – a questionnaire would suffice. This is not an important factor for this research because Kuwait is a very small country which could be covered by the researcher during data collection. However, there might be a need to explore other industries close to Kuwait within the Gulf region.

As far as the interviews are concerned, they can be based on the questionnaire because the questionnaire design determines the required information and can be complemented by interviews. The idea is to go and interview respondents after their questionnaire response to get detailed data and validate the results after collation. It is also important to collect information from the refineries about quantitative data on risk modeling, so when interviewing respondents there could be a chance to view case study data.
5.7.6 Experimental Research
Silverman (2000) said that “experimentation can be viewed as an extension of inquisitiveness; experience carefully planned in advance”. Specifically, it is the method of manipulating levels or amounts of selected independent variables (causes) to examine their influences on dependent variables (effects). This method cannot be used for the research at hand.

5.7.7 Questionnaire Design and the Method of Maximising Response
The questionnaire has been designed to comprise six major sections. The idea is to ensure that questions can be asked about the status quo in terms of how best to integrate technical and non-technical risk assessment systems in areas where culture can significantly stifle the perception of hazards. The rationale has been to examine the questions so as to assess the levels of social-cultural negativity, if any, on the risk assessment process for Kuwait oil and gas facilities.

The major feedback from the examination report concerns the issue of “psychology of risk” with specific issues relating to the theory of bounded rationality and how people tend to develop their thinking not only about risk.

Figure 5-3 expands the theoretical framework by showing the key steps of the research as well as the major issues that need investigation. The chapter on the psychology of risk therefore is modelled on Figure 5-3 by concentrating on social values, cultural values and the decision theory. Then the research can be linked to the impact such information would have on the implementation of risk assessment in the oil and gas industry in Kuwait. A detailed questionnaire has been added to appendix A.
Integrated Risk Management Systems

Non-Technical Drivers for Risk Management

Cultural Values

Social Values

Decision Making Theory

Psychology

Perception of Risk

Religious beliefs

Technical Risk Management Processes

Structured Risk Systems

Health and Safety Practice

Lean Operations

What is the Impact on Risk Management on Kuwaiti Oil Refineries?

Figure 5-3: Expansion of tier 2 of the theoretical framework
5.8  **Action Research**

According to Susman and Evered (1978), action research has the following characteristics:

- Future oriented, trying to empower the future of people
- Collaborative, obliging researcher to clarify and represent their own ethics and values
- Implies system development
- Generates theory and is grounded in action
- Agnostic, in that theories and prescriptions for action are themselves the product of previously taken action
- Situational, based on actors defining their current situation

5.8.1  **Case Study**

(Hussey and Hussey, 1997) defined a case study as “an extensive examination of a single instance of a phenomenon of interest and is an example of phenomenological methodology”. It is important to put the method into context because it focuses on the understanding the dynamics present within a single setting and it must be constructed with a view to being sensitive to the context in which management behaviour takes place (ibid). It can take the following form according to Hussey and Hussey (1997):

1. **Descriptive** – case studies where the objective is restricted to describing current practice;
2. **Illustrative** – case studies where the research attempts to illustrate new and possibly innovative practices adopted by particular systems (firms);
3. **Experimental** – case studies where the research examines the difficulties in implementing new procedures and techniques in an organisation and evaluating the benefits;
4. **Explanatory** – case studies where existing theory is used to understand and explain what is happening.

The following steps would be necessary to carry out a case study:

(i) selling a case study; (ii) preliminary investigation; (iii) data collection stage; (iv) data analysis stage (v) reporting stage.

Advantages of a case study are (Naoum, 2006) that it: (i) develops analytic and problem solving skills; (ii) allows for exploration of solutions for complex issues and (iii) allows students to apply new knowledge and skills.
Disadvantages of the questionnaire are: (i) it may not seem relevant to a participant’s own situation; (ii) insufficient information can lead to inappropriate results and (iii) it may not be appropriate for elementary level.

The use of case study data when the author visited oil refineries was considered to be essential for this research.

5.8.2 Observation Research
This falls into the category of field research, where the research consists of a collection of methods that include direct observation of naturally occurring events (Silverman, 2000). Kumar (1999) defines observation as a purposeful, systematic and selective way of watching and listening to an interaction or phenomenon as it takes place. Observation is one way of collecting primary data. This method will not be used because there are three proposed methods already.

5.8.3 Flow Chart for Adopted Methods
Figure 5-4 summarises the key steps that have been used for data collection.

Step 1: There was an extensive review for literature about the psychology of risk, in chapter 2 of the dissertation. We see that the literature concerning classical decision theory and how decisions are influenced by cognition has also been examined. In chapter three, there is a review of literature concerning lean management and how it has been used to trigger cost cutting measures in the oil and gas industry in general. The same chapter also covers safety culture in the oil and gas industry around the world and how various countries have been responding to safety in general. It tries to link the uncertainty model to human psychology. In chapter four there is a review of literature which is linked to a synthesis of the information so as to pave a way for the research to integrate occupational health with the oil and gas industry, hence creating a link between social and cultural values within the decision making process for personality risk management.

Step 2: There is an explanation about the key research methods that have been adopted, based on the research philosophy as well as the approach to reasoning. This was covered in chapter 5. Three methods will be used for collecting primary information: (i) questionnaire survey; (ii) 2 case studies and (iii) interviews. The data analysis has been presented starting
with the questionnaire survey followed by the explanation of the two case studies. Finally, the information from interviews has been included in the discussion as well in answering research hypotheses.

**Figure 5-4: A flow chart showing the adopted research methods**

**Step 3:** The research will use primary data collected from interviews, questionnaire and a case study to perform a detailed analysis so as to produce results which will be useful in arriving at conclusions and recommendations for the research. We can therefore conclude that the steps to be used in the research process, herein shown in Figure 5-4, give a true reflection of the research approach that will be adopted from the onset of the research project. They will also yielded clear results about the impact that social and cultural values have been
having on health and safety risk management in the oil and gas industry of Kuwait and the MENA region.

5.9 Summary

The primary data needed to assess the impact of social-cultural values on health and safety risk management in oil refineries in Kuwait can be considered to be qualitative and quantitative in nature. For instance, if it is possible to obtain the temperature readings for the central storage vessel, it would be possible to quantify and simulate the temperature levels to see how the vessel would behave should the temperature reach certain levels. However, this is not possible because there are many components whose quantitative data would be required and the simulation of each component of the refinery would be difficult to fit within this dissertation. On the contrary, the collection of information about the operations of the refinery, especially the implementation of risk assessment and risk management can be done through the questionnaire, interviews and or by observing the processes as they take place. This chapter has shown that, depending on the research questions, it is possible to design a primary data collection mechanism that would be ideal to answer the questions. In this dissertation a questionnaire was found to be the most ideal way of getting the primary information from the refinery.
6. CHAPTER SIX: DATA COLLECTION AND ANALYSIS OF RESULTS

6.1 Introduction
For this research to adequately evaluate the impact of social-cultural values on health and safety management in oil refineries in Kuwait it was imperative to gather primary information from a sampled population so as to gain an understanding of their perceptions about occupational health and safety risks in the refinery. This chapter examines the response from a questionnaire survey conducted in Kuwait over a period of two months. The questionnaire was divided into six sections. Therefore the presentation of results herein has been designed to follow the sequence of questions as they were presented on the questionnaire.

Out of the sample of 125 respondents (n) there were only 64 valid responses to the questionnaire survey. This worked out to be 51% of the targeted sample.

6.2 Section One: General Information about Respondents
The oil and gas refineries in Kuwait employ a variety of professionals and a general workforce whose specialisations can vary from those related to the business of refining oil and gas to support services for the business. Therefore, the first question related to establishing the roles that respondents held.

Question 1 asked respondents to select their official position at the time of the survey. The choices given to them included, but were not limited to (i) Engineer, (ii) Manager, (iii) Risk Manager, (iv) Senior Manager, (v) Mechanic, (vi) Safety Manager and (vii) Financial Manager; there was a further category for (viii) any others profession or position. The general terms such as engineer, manager, risk manager and senior manager did not necessarily cover as many respondents as they could. Figure 6-1 shows that the “other” category had 23 respondents (36%) seconded by engineers at 13 respondents (20%). There were only 7 senior managers (11%), 6 mechanics (9%), 5 managers (8%), 4 risk managers (6%), 4 safety officers (6%) and 2 financial managers (3%). Figure 6-1 shows that there was a good representation of professionals across the refineries. The ‘other’ profession shown in Figure 6-1 represented the technical operatives that were working different roles such as
technologists, technicians and riggers as well as petro-chemical specialists. The list also includes officers that were working as process performance monitors and quality assessors for the processes.

**Figure 6-1: Official positions at the time of the survey**

Like any other industry, the turnover for the oil and gas workers can be high within the Middle East. Therefore, it was necessary to gain an understanding of the number of years that respondents had been working in the firm. As a result, question 2 asked respondents to select the range of years that represented the time they had worked for the company. They were given a choice of (i) insignificant experience, (ii) 1–5 years, (iii) 6–10 years, (iv) 11–15 years and (v) more than 15 years (shown in Figure 6-2).
Figure 6-2: Years of experience in the oil and gas industry

Figure 6-2 shows that the highest level of experience from respondents was between 6 and 10 years (45%). Only 11 respondents (17%) had industrial experience ranging between 1 and 5 years. There were 18 respondents (28%) with more than 15 years’ industrial experience, and 5 respondents (8%) had experience ranging between 11 and 15 years. Only one respondent had insignificant experience of less than 1 year. The information shows that in the refineries there are extremely experienced people and that there are those with little experience of the hydrocarbon industry as a whole.

It was important to complement questions on experience with those relating to the industry where experience may have occurred. Therefore, question 3 asked a specific question relating to experience in the Kuwait oil and gas industry. Respondents were given a choice of (i) insignificant experience, (ii) 1–5 years, (iii) 6–10 years, (iv) 11–15 years and (v) more than 15 years (see Figure 6-3). The response shows that 27 respondents (43%) had 6 to 10 years of experience in Kuwait; 23 respondents (37%) had between 1 and 5 years of experience, and 6 respondents (10%) had 11 to 15 years of experience. Only 5 respondents (8%) had more than 15 years of experience in Kuwait. This information shows that there is an adequate to vast level of experience in the Kuwait hydrocarbon industry such that the sampled respondents could comment on risk and occupational health.
Kuwait is not the only nation with an established oil and gas industry where people may have worked. For instance, there are expatriate workers that have been employed by their parent firms that are engaged by the government, such as Chevron. It was, therefore, important to gain information relating to experience outside Kuwait. Therefore, question 4 is justified because the technology that is being used in Kuwait has a huge international dimension to it. The response in Figure 6-4 shows that 28 respondents (48%) had an insignificant experience abroad; 15 respondents (24%) had between 1 to 5 years of experience abroad; 8 respondents (13%) had some form of international experience for 6 to 10 years. Only 7 respondents (11%) had more than 15 years of experience working outside Kuwait and 5 respondents (8%) had between 11 and 15 years of experience.
It is important to note that respondents had international exposure of some kind, even though some selected the choice for insignificant exposure. The main reason cited for gaining information about international exposure relates to training programs and the sponsorship by parent companies to train their workers. It is also important that some of the expatriate workers had international exposure prior to taking up work in Kuwait.

When you compare question 5 with 6, it is apparent that the most experienced respondents were the ones who selected the age category 41 to 50 years (37%) and the over 51 years of age (22%). However, Figure 6-5 also shows a significant number of respondents under the age category 30 years or below (24%) and a slightly lower number of respondents in the age bracket 31 to 40 years (17%) (see Figure 6-5). This is to be expected because the petrochemical industry represents a specialised field of work that relies on an experienced workforce.
Figure 6-5: Range of years representing age

Question 6 asked respondents to select educational qualifications that best represented their current status with choices given as follows: (i) diploma, (ii) bachelor’s degree, (iii) master’s degree, and (v) doctorate. The reason for asking such a question is because the level of education and training given to a worker largely depends on their educational background. In addition, the official position one may have in the organisation, as well as the level of responsibilities, largely depends not only on experience but also the standard of education. In response, there were many highly qualified officers in oil refineries in Kuwait as shown in Figure 6-6. A total of 26 respondents (41%) had a Bachelor’s degree; 13 respondents (20%) had a second degree while 20 people (31%) had a diploma, with 5 people (8%) with high school level qualification who had moved on to a profession through in-house company training through apprenticeships. There were a mixture of age categories, international experience and exposure to the oil and gas industry. The respondents were heavily involved in the oil and gas refining business in various capacities regardless of their qualifications and experience.
Apart from educational background, it was important to state the country or region from which each respondent originated at the time of the survey. Therefore, question 7 asked respondents to select their country or region of origin. The ideal was to avoid being specific except for those that were Kuwaiti and so the choices given were (i) Kuwait, (ii) Middle East and North Africa, (iii) Europe, (iv) USA or Canada and (v) Other. 35 respondents (56%) were originally from Kuwait, 11 were from Europe (17%); 7 respondents (11%) were from the Middle East and North Africa; 6 respondents (10%) were from the United States of America and or Canada while 4 respondents (6%) were from other parts of the world including, the rest of Africa, Australia and South America.

The response is presented in Figure 6-7 and it shows that there is a multi-national element in the Kuwaiti oil and gas sector. This attribute is a result of the international investment that has been taking place in the country where companies based in other parts of the world have heavily invested in the oil extraction and refining business. However, the balance between expatriates and the local workers was adequately considered at the sampling stage such that there was a significant inclusion of local people so as to gather their opinion about the perception of risk and the way it impacts on occupational health in the industry.
Figure 6-7: Country or region of origin

The importance of section one of the questionnaire cannot be over emphasised because when you reflect on the issue of bounded rationality (section 2.2 of the dissertation) as well as the decision making models (section 2.3) it is obvious that the level of education, age, level of experience as well as place of origin could have an impact on the way people make decisions. Similarly, the issues of culture as examined in section 3.10 could equally be aligned with these key factors that have been covered in this sub-section. It was, therefore, important to have this information as a way of correlating the responses and ensuring credibility, reliability and validity of the responses.

6.3 Section Two: Lean Practices in the Refinery Operations

Section two of the questionnaire was designed to contain questions that related to the orderliness of the operations in relation to the design. It also contained questions relating to management waste in the production process, especially wastage that could be reduced without necessarily affecting the occupational health risks to the users.

The first question in this section was question 8 which asked respondents if they felt that the oil refinery plant they worked in had been designed to be operated safely. Respondents were given four options: (i) categorical ‘no’, (ii) ‘yes’, (iii) ‘don’t know’ (iv) ‘no comment’. The
choices were designed in such a way that a respondent could answer or refuse to comment if they felt they did not want to.

From the response presented in Figure 6-8 it can be seen that the overall perception of 43 respondents (67%) was that the facility was designed to be operated safely. 9 respondents (14%) selected the ‘don’t’ know’ option while 6 respondents (9%) selected the ‘no’ option. However, 6 respondents (9%) did not comment on the design of the facility. Further analysis of the results on Figure 6-8 shows that there was a belief that the design of the facility in question was extremely safe; however, when we combine the 6 people that thought otherwise with those that did not comment, we end up with 12 people that were undecided about the safety levels embedded in their refinery. Scepticism about safety is a human factor issue, and it is acceptable.

![Perception of the safety design incorporated in the oil and gas facility](image)

**Figure 6-8: Perception of the safety incorporated in the oil and gas facility**

Question 9: Does your department get involved in the segmentation and segregation of the production processes? There are various units in any refinery, depending on the stage of the process. There are sections of the process that require segmentation and separation of constituent parts of the raw materials. The response to question 9 shows that 31 respondents (50%) were involved in the separation and segmentation process; 13 respondents (21%) were not involved while 11 respondents (18%) did not know if their tasks included segmentation.
respondents (11%) did not comment. See the information presented in Figure 6-9 which summarises the results from the survey.

Kuwait has been developing various types of oil extraction methods some of which include the steam flooding techniques as well as other conventional methods of extraction. Therefore, the process of segregation and segmentation is crucial to the industry, just like the process of gas sweetening (a chemical process that aims to control the chemical content of natural gas). It was therefore important to test the level of efficiency of such technical processes of segmentation and or separation in question 10. The question used a likert scale of 1 to 5 where 1 stands for “Highly Inefficient”, 2 stands for “Inefficient”, 3 stands for “Not sure”, 4 stands for “Efficient”, and 5 stands for “Highly Efficient”. It asked respondents to rate the level of efficiency of the segmentation of the oil refinery they work from. Efficiency is crucial in the separation process because of the heavy equipment used as well as the likely negative impact due to varying levels of toxicity of the oil based products. Figure 6-10 paints a picture whereby 23 respondents (37%) were of the view that the process of separation of products was efficient, but 22 respondents (35%) were not sure about the efficiency of the processes. 8 respondents (13%) were of the view that the process was inefficient while 5
respondents felt that the process was highly inefficient. Only 4 respondents (6%) reported that the gas sweetening and separation processes for the oil products were highly efficient.

Figure 6-10: Perception of the efficiency in separating oil and gas products

It was also important to ask for information relating to the perception of the flow of products in the refinery. Therefore, question 11 asked if the flow of oil and gas products was well arranged in the factory or not. The design of refineries can vary and the operations that take place therein are bound to be influenced by the design. This factor, however, did not matter that much because Figure 6-11 shows that 37 respondents (58%) felt the flow of the products was well organised; 24 respondents (38%) did not know if the flow was organised well or not. Only 3 respondents (5%) did not comment on the question.

Knowledge about the movement of the product is crucial to the industry because the processes are supposed to be monitored and evaluated, and that decision making takes place at all times, especially when there are variances in the chemical composition or readings from the key instruments vary from the norm. It is worth noting, however, that 28% of respondents were not sure whether the flow of the products was arranged well or not, meaning that their work heavily relies on particular components not on the broader working of the refinery.
Another key issue is the general tidiness of the processes where respondents worked. Question 12 related to the perception about the general cleanliness and orderliness of the installations before they were used in the refining process. This included the feeding vessels and the receiving ones and also covered the containment vessels as well as the site bunds that can protect potential spillages. A five point likert scale was used for respondents to choose from: (i) highly untidy and poor orderliness, (ii) untidy and poor orderliness, (iii) not sure, (iv) tidy and good orderliness, (v) very tidy and high orderliness.

In response, 25 respondents (40%) stated that they were not sure of the level of tidiness or orderliness and how it could be measured against an acceptable measurement yardstick, hence they were not sure if the work environment was tidy or not (Figure 6-12). However, 19 respondents (30%) stated that their work environment was tidy and orderly, while 13 respondents (21%) felt that their work environment was very tidy and highly orderly. 6 respondents (10%) stated that their work environment was untidy and poorly ordered. Further analysis shows that the most untidy areas were the feeders and those that received the raw materials, including the steam areas as well as the general separation testing rooms.
In any refinery, standard procedures are necessary to ensure that the designed process can work as effectively as possible. Therefore question 13 related to whether respondents were aware of the standard way of reducing operational waste. The rationale behind this question was that, in as much as the refinery could provide standard operational procedures, there could be no indication of deliberate moves to institute standard waste reduction within the operations (Figure 6-13).

**Figure 6-12: Testing the perception of the general cleanliness and orderliness at the facility**

**Figure 6-13: Standard way of reducing operational waste in the department**
Figure 6-13 shows that 26 respondents (41%) acknowledged the procedure for waste reduction; 17 respondents (27%) were not aware of such a deliberate procedure of reducing waste while 12 respondents (19%) stated that there was no such procedure in the area in which they were working. Only 8 respondents (13%) did not comment on the standard procedures for reducing waste in the production process. The results show that some units have been instituting deliberate measures to manage operational waste while others have no standard procedures to reduce waste. The total number of respondents who did not comment, or those that were not aware of the management of waste in the production process was 59%, meaning that any deliberate move to manage operational waste has not been considered fully by many units in the refineries.

Question 14 followed up on the previous question by setting a likert scale of 1 to 5 where 1 stands for “Highly Inefficient”, 2 stands for “Inefficient”, 3 stands for “Not sure”, 4 stands for “Efficient” and 5 stands for “Highly Efficient”. The question asked respondents to rate the level of efficiency of the waste management system present in their factory. The response, which is presented in Figure 6-14, shows that more respondents did not think there was efficiency in the waste management system than otherwise. It is worth noting that 24 respondents (38%) felt it was inefficient, 8 respondents were not sure (13%) and 5 respondents were of the view that the process was highly inefficient (8%).

![Efficiency of the waste management system](image)

**Figure 6-14: Perception of the efficiency associated with the waste management system**
However, 18 respondents (29%) stated that their waste management system was efficient and 8 people (13%) stated that their system was highly efficient (Figure 6-14). This shows that in some sections the waste management is efficient while in others it may not even be in existence. Without a system for reducing operational waste, it becomes difficult to apply the principles of lean management (section 3.2) such that the effort linked with waste management can easily turn out to deliver cost cutting measures as the main goal. In such a scenario, occupational health and safety risks can easily get embedded in the production process (section 3.5).

Question 15: Do you think the procedure for reducing waste in the production process has a positive impact on risk behaviour for the workforce? The rationale behind this question was to test the appreciation of the fact that decisions made about reducing waste in the production process could have an impact on the overall perception and treatment of risk (Figure 6-15).

![Figure 6-15: Testing if the procedure for reducing waste has a positive impact on occupational health and safety](image)

The perception of the respondents was that reducing waste in the production process could have a positive impact on risk, as stated by 34 respondents (53%), while 15 respondents (23%) did not know if that could be the case. 10 respondents (16%) did not comment, while 5 people (8%) did not think reduction in waste could result in a positive impact on risk in the
work place. If you compare the response to question 15 with that of question 14 it becomes obvious that there is a perception from respondents that the process of waste reduction has risk assessment embedded in it because once the reduction of waste commences, there is a positive impact on risk perception. This implies that risk assessments are part of the waste reduction processes.

Apart from the standards put in place in the work place, there is the issue of self-discipline and commitment that is expected from the workforce each time they are assigned tasks that are aimed at reducing operational wastage. In question 16, respondents were asked if they observe self-discipline and commitment from the workforce when they are implementing waste management processes. The issues of self-discipline and commitment were meant to test the work culture and the strictness with which respondents are meant to perform within the refinery.

Figure 6-16: Testing the ability to observe self-discipline and commitment to the waste reduction process

Figure 6-16 shows that only 5 respondents (8%) believed that there was no self-discipline and commitment in the refinery; 31 respondents (50%) stated that there was self-discipline, while 17 respondents (27%) didn’t know about the issue of self-discipline and commitment. However, 9 respondents (15%) did not comment on the issue. The 15% of respondents who did not comment were all expatriate workers and in higher official positions. There was a
perception that work commitment is there, but self-discipline is lacking in some elements of the work. When you consider the cultural differences in the work place, it is difficult to establish an acceptable standard for all to measure self-discipline or commitment.

As in any other industry, the oil and gas sector of Kuwait needs to keep training its people, not only from the point of view of technical elements but also the issues of work culture, waste management and lean production. Therefore, question 17 basically asked about any form of training programs for the workforce that the respondents may have attended. The response to the question is shown in Figure 6-17 where 13 respondents (20%) did not think there was any form of training available in their work place; 35 respondents (55%) confirmed the existence of training programs; 14 respondents (22%) were not aware of the training programs and 2 respondents (3%) did not comment. Induction is a form of training, and nearly everyone is inducted in the work environment. However, specific forms of training may not be available for some departments, especially for those who have prior certification to operate in the oil and gas sector. However, one could argue that the total number of people that were not aware of the training provisions is high, and this could be a communication or information dissemination issue.

![Figure 6-17: Does the organisation provide training for the workforce?](image-url)
So far, the section on lean practices has demonstrated that the refineries have standards for operations whose aim has been to foster reduced waste in the production process. Because the workers are not overly exposed to the product, the practices of segmentation and separation were seen as essential elements in reducing operational waste, either by cutting down on spillages or through monitoring the processes ensuring there is a strict adherence to the operational standards. However, there is a mixed approach to the application of risk as the work proceeds, and the self-discipline of the workers needs to be in line with the international standards. Training is readily available, but the primary information shows that not everyone takes advantage of the training programs either because they are not aware of them or do not need to be in their level of work or because their section has not communicated the necessary training programs.

6.4 Section Three: Personality Risk Management Processes in Refineries and the Impact they have on Occupational Health and Safety

Apart from the production processes, it was important to gain an understanding of how the integration of risk management processes has been implemented at the refinery level with a view to assessing the adherence to fundamental principles of risk assessment as well as testing the impact on occupational health and safety of those who work therein. Emphasis on procedure and decision making was maintained so as to gather information about the impact of the decision making on the occupational health and safety of the workforce.

The first question from this section was question 18, whose main focus was to ask for the involvement in making decisions that affect the safety of other people or the protection of key installations. This question was also related to the level of responsibility individuals had for themselves as well as fellow workers. The response to question 18 has been summarised in Figure 6-18 where the highest score was for the 36 respondents (56%) who confirmed that they were involved in the decision making that had an impact on occupational health and safety. However, 12 respondents (19%) did not know if their decision making had an impact on occupational health, while 9 respondents (14%) stated that they did not make decisions. Only 7 respondents (11%) did not comment mainly because their role was administrative and they were not involved in the risk assessment programs.
However, it was noticed that the officers who did not comment have a role in resourcing and equipping the operations so that the refinery can maintain a high standard of occupational health and safety. For example, the human resource personnel as well as the financial managers have a role to play in the procurement of tools, equipment and protective gear and the training that is needed for workers to be informed of their roles and responsibilities. This shows that occupational health and safety is seen as a technical issue, rather than an organisational issue by some professionals.

Figure 6-18: Did respondents make decisions that impacted on occupational health and safety in the workplace?

Question 19: Does your job involve responding to the decisions that are necessary for the safety and integrity of the refinery? Responding to incidents of safety and the integrity of the facilities is supposed to be the responsibility of every worker; this is because of the volatility of the product. If there is an incident, there is a high likelihood that the damage could spontaneously develop into an exponentially vast problem; hence the training provided to every worker requires that they contain, as far as possible, areas that could be prone to incidents. The response in Figure 6-19 shows that not everyone is fully involved in the decision making that pertains to the safety and integrity of the refinery; however, 34 respondents (56%) reported that they make such decisions, while 15 respondents (25%) did not know if their decisions were necessary for the safety and integrity of the refinery.
respondents (11%) were sure that their decisions did not relate to the safety and integrity of the refinery, while 5 respondents (8%) were not able to comment. This shows that there are many decision makers at every stage of the refinery all of whom think about the safety and integrity of the refining process. However, a good number of respondents did not know the ultimate benefactor of the data generated as they assessed risk because of the specialisation within the refinery. However, the ultimate goal is to ensure that everyone is safe.

![Bar chart showing responses to the question: Do you make decisions necessary for the safety and integrity of the Refinery?](image)

**Figure 6-19: Do you make decisions that lead to a response on matters relating to the safety and integrity of the refinery?**

The other way of looking at the integrity of occupational health and safety in the refinery is to assess the level of involvement in the risk assessment cycle. The cycle, or assessing risks of any sort (section 4.2), requires a systematic approach whereby events are planned and evaluated as the work proceeds. Therefore, it was vital that question 20 ask respondents to assess their level of involvement in the planning for the risk assessment processes. The planning herein implies the selection of key factors to target so as to be able to resource the plans at the stage of implementation. In response, we see that 27 respondents (43%) did not take part in the planning for risk assessment; only 24 respondents (38%) took part in the planning. However, 7 respondents (11%) did not comment about the planning process for risk assessment, while 5 respondents (8%) did not know about their responsibility to participate in the planning process for risk assessment, see Figure 6-20. The level of involvement in
planning for the day-to-day standards relating to risk assessment planning for occupational health and safety is below 50%. This means that there were many respondents that were not involved in the planning for safety. The alternative interpretation is that there were no provisions for planners to engage staff working at the operational phase so that they could be included in the decision making process by ensuring they were taking part in the planning. However, evidence in Figure 6-20 paints a different picture.

![Bar Chart](image.png)

Figure 6-20: Testing the level of involvement in the planning for risk assessment in the workplace

Planning for risk assessment is driven by the tools available for risk assessors to use. It was, therefore, important to ask for the level of awareness of the tools used at each refinery. Hence, question 21 asked respondents to state their awareness of the risk assessment tools for the oil and gas industry in general, even if those tools were not being used at their refinery.

The response shown in Figure 6-21 paints a picture that there is a good level of awareness of risk assessment tools because 26 respondents (42%) affirmed the question, while 15 respondents (24%) selected the negative answer, and 18 respondents (29%) did not know if they had full knowledge of the risk assessment tools. Only 3 respondents (5%) did not comment on the tools for risk assessment, as their line of work was different from that
needing risk assessment. At the refinery level, there are many workers that need risk assessment each time they do a task so that their safety and that of others can be assured. However, the tools used vary from section to section and the detail with which risk assessment is performed largely depends on the area of the refinery in which someone works. There are sections that are prone to incidents and are regarded as risky, while others are not that risky.

![Figure 6-21: Testing the awareness of the risk assessment tools for the oil and gas industry](image)

Question 21 also asked for an explanation of the choices that respondents made on this question. Most of the tools available to those that have been conducting risk assessments were paper templates and data monitoring display units (computerised monitors). Monitoring the process was crucial to risk assessment. As for those dealing with the raw materials, the work was more to do with the performance of their tools and how well prepared they were for responding to changes.

There was a need to test the perception of lean principles and the way they impact on or are impacted on by risk assessment approaches in the refinery. Therefore, question 22 asked respondents to rate the application of lean principles when they are performing their risk
assessment at work under the following headings: (i) Waste and Efficiency (W&E), (ii) Planning and Control (P&C), (iii) Customers focus (C-F), (iv) Continuous Improvement (C-I), (v) Cooperative Relationships (C-R) and (vi) Systems thinking (ST). A standard five point likert scale was used. The scale of 1 to 5, meant that 1 stood for “very low”, 2 stood for “low”, 3 stood for “moderate”, 4 stood for “high” and 5 stood for “very high”.

The idea of testing the perception of lean management principles (section 3.3) against the risk assessment culture in the work place (section 3.11) was deemed to be fundamental to the research because the test offers a comparative approach to evaluating the decision making and its impact on occupational health and safety. For instance, if the waste and efficiency are seen as the paramount factors, there may be no focus on the customer, or it may be that departments are working in isolation. Figure 6-22 demonstrates that respondents were of the view that waste and efficiency considerations (W&E), planning and control (P&C), customer focus (C-F) and systems thinking (S-T) were moderately considered in the risk assessment process. Table 6-1 shows a 30% highest rate for waste and efficiency management, 37% for planning and control, customer focus at 31% and the system thinking.

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<th>Table 6-1: Colour coded Response to question 22</th>
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<tr>
<td>Waste and Efficiency (W&amp;E)</td>
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<td>Planning and Control (P&amp;C)</td>
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<td>Systems thinking (ST)</td>
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Table 6-1 also shows that respondents were thinking that continuous improvement and cooperative relationships were of higher importance in risk assessment.
Figure 6-22: Rating of lean management principles and the impact on risk assessment at the refinery
There are weaknesses in the way risk assessment and or perception is seen by respondents. For example, nearly all refineries are systems of processes with the product moving from one vessel to another; therefore, one could expect that the risk assessment between units of the refinery should be viewed as being of the highest priority. Another example is the issue of waste management and efficiency in the production process. Any waste in the oil and gas could be a signal of inherent weaknesses in the process and so the risk assessment needs to be linked to how waste is managed and how efficiency is promoted. However, the response to the question shows a lack of systems thinking when there are issues of risk to the departments partly due to the compartmentalisation of the refining process.

6.5 Section Four: Social-Cultural Values in the Work Place

The focus of the research has been on the social and cultural values within the oil and gas refinery environment with a view to decision making that could impact on the occupational health and safety of the workers. It was therefore imperative that the questionnaire comprised questions that related to the social and cultural values that not only linked decision makers to lean management but also had a link to risk assessment.

One of the key issues about social and cultural values is the way people get employed in the refinery. Question 23 asked respondents if they had family ties in the work place. The Arabic culture of connections and clans is one possible way for someone to get into the industry as an oil worker. The concern for the research was how connections could be linked to decision making and the behaviour of people in the work environment.

The response that has been presented in Figure 6-23 shows that there were not many respondents with family ties in the business. For example, 49 respondents (77%) stated that they did not have any family ties; 13 respondents (20%) had family ties, and 2 people did not comment on the question. Those with family ties were not necessarily close families, but those who had family ties in clans and the way they related to others within the business. The main issue, therefore, was whether there had been family influence in getting into the oil and gas industry as would be the case with other industries. However, where there are family ties, one would expect specific behavioural patterns relating to how those in the business longer than the new comers could influence their counterparts more easily.
As with the previous question, it was important to establish the working relationships with teams in the workplace; hence, question 24 asked respondents to state if they had friends working in the same place. 45 respondents (71%) had friends in the workplace, 12 respondents (19%) did not, while 4 respondents (6%) did not know if their social relations were friends or not, and 2 people did not comment (Figure 6-24).
It is a cultural norm to have colleagues as workmates or to develop social networks in the work place in Kuwait. Social networks have been crucial in the way people understood and practiced their work culture (section 3.11.1 – 3.12). In turn, their decision making can easily be affected by their attitude towards work. We also notice that professionals could easily avoid decisions related to uncertainty and that culture has a role to play in the decision making process. Therefore, question 25 asked respondents if they had people they trusted to work with. This simple question means a lot to people that are working as a team because decisions have to be trusted before they can be acted upon. In response, Figure 6-25 shows that 47 respondents (75%) worked with people they trusted; 47 respondents (11%) did not know if they had such people, while 5 respondents (8%) made no comment. Only 4 people (6%) stated that they had no trusted people they worked with.

![Figure 6-25: Availability of trusted workmates in the refinery](image)

From the information presented in Figure 6-25 there are strong social networks in the refineries, and this is a positive sign that social and cultural relations exist in the work place. Following on from this, question 26 asked for any evidence regarding the work culture. It asked for information relating to how or if the work culture allows formal recognition or respect for the official position of people in their decision making. The Arabic culture allows for a clear distance between authority and those to whom it is meant to be administered, and
this may have an impact in many work places. Even the social network could have an impact on the way people relate in dispensing instructions. In response, 49 respondents (78%) stated that authority is highly recognised; 13 respondents (21%) felt that they were not very sure about authority and only one person did not comment on the question (see Figure 6-26).

![Are you allowed formal recognition or respect for decision makers?](image)

**Figure 6-26: Testing the formal recognition of authority or decision makers**

The response to question 26 is to be expected because authority is a cardinal element of Arabic culture and it can be demonstrated not only in the work place but also in social contexts. However, there were expatriates too, whose cultural perspective of authority may have varied. It is very possible that they command another type of authority, especially one linked to technical competence.

In question 27 respondents were asked to state if they consider age a key indicator of authority by decision makers. This is an important question because in some cultures experience is associated with age and so authority is also associated with age. This implies that those who are seen to be more experienced could wield more authority over others regardless of their technical competence. Figure 6-27 shows that 34 respondents (53%) did not think that age was an issue in the refinery, while 13 respondents (20%) stated that age was an important factor that was considered within the refinery. However, 17 respondents
(27%) did not know if age was a factor in the determination of the authority at the decisions level of the factory. Most of the expatriate workers were not sure if age was an issue; however, all the 13 respondents that acknowledged age as an issue were locals as well as those of Middle Eastern origin.

![Figure 6-27: Testing if age is a key indicator of authority by decision makers](image)

The main aim of considering social and cultural values, networks and the like was to see if decision making is influenced by such factors. It was, therefore, important to ask in question 28 about the perception concerning the influence these factors may have. The question stated, ‘using a likert scale of 1 to 5 where 1 stands for “Highly unlikely”, 2 stands for “Unlikely”, 3 stands for “Not Sure”, 4 stands for “Likely” and 5 stands for “Most likely”, what is the likelihood that you would be influenced by your social-cultural “gut feeling” when making technical decisions?’ In response, the highest score was recorded from the 25 respondents (40%) who were not sure their attributes would impact on their technical decision making, and the second highest score was recorded from 18 respondents (29%) who selected the ‘likely’ option. However, 9 respondents (14%) stated that it was ‘unlikely’, while 7 respondents (11%) selected the ‘highly unlikely’. However, 4 respondents (6%) selected the most likely choice. The trend-line on Figure 6-28 shows that the respondents did not wish to link their technical decision making to the social and cultural factors that their teams may
possess in the refinery. The explanation behind this trend of response was such that the respondents strongly argued that their technical competencies outweigh their social and cultural connections such that they can function without being affected by their social networks.

There was a realisation, however, that belief in the social and cultural patterns in work have a negative impact on productivity and the perception of risks. This suggests that training programs have been highlighting the issue of human decision making and what impacts on the decisions. If you compare and contrast the explanation with the issues of education in Figure 6-6 about academic qualifications and link it to the training question in Figure 6-17, it becomes apparent that there was a sizeable number of fresh entry qualified people, who may not have been involved in training, that can deal with the impact of beliefs from a social and cultural context. Therefore, Figure 6-28 confirms that many people are not sure of the link between social and cultural beliefs and values in their decision making.

Question 29 was more direct because it asked respondents to state what they could do in a specific situation. It asked, ‘when faced with a decision related to risk, would you decide based on technical information even though it would go against your personal beliefs?’ The
importance of recognising someone’s beliefs in the work environment cannot be over emphasised. Section 3.5 discussed the issue of social desirability and how it affects decisions when performing risk assessment. In addition, section 3.11.3 also looked at human psychology and the desire people have to control things which, in turn, could impair judgement. All these factors relate to the way a person uses their beliefs each time they are asked to make a decision. In descending order, 24 respondents (38%) were not sure if they could rely solely on technical data without any influence from personal opinion or beliefs. However, 18 respondents (28%) stated that they would most likely rely on the technical data than personal beliefs. 9 respondents (14%) suggested that it was highly unlikely for them not to ignore social and personal beliefs; 5 respondents (8%) said it was unlikely, while 8 respondents (13%) felt that it was likely that they would ignore personal beliefs (Figure 6-28).

![Figure 6-29: Does technical data supersede personal opinion and beliefs when making decisions?](image)

The explanation given for their choices varies; however, the main thread of their argument has been that their technical competence outweighs their personal opinion, although they believe that there is no way of ruling out personal beliefs in the decision making process. For those who think that they cannot easily ignore their personal beliefs, they cited reasons such as the experience in the business which might make it possible for them to see difficulties
even before detection equipment is reliable. For example, they are likely to replace a component even before they can confirm failure based on data collected. This is because there are some signs that are not necessarily technical in nature. Flexibility was another key issue cited by respondents, whereby the use of flexible data analysis can lead to better decisions as promptly as possible.

6.6 Section Five: Testing the Bias on Technical Risk Assessment

Section five of the questionnaire was designed to be more direct in addressing factors that have been identified as triggers for possible bias in technical decision making for risk assessment. The questions were mainly categorised in two parts: (i) the human factors and (ii) the religious factors. These two categories have been identified in the literature (section 2.5) as being cardinal to the management of occupational health and safety risks in the workplace.

6.6.1 Human Factors

The first question in section five, part one was related to the human factors associated with the adherence to procedure. It was learned in sections 4.6.1 and 4.6.2 that human factors have been known to contribute to accidents within the industry. There are many reasons for this; one of them is simply the monotony of adherence to procedure when people get so used to procedural working such that it loses meaning. Therefore, question 30 asked for an opinion on how strictly respondents followed the work procedures, manuals and checklists at work. The response shown in Figure 6-30 indicates that 26 respondents (41%) strictly adhere to the procedures, manuals and checklists. Such a response is to be expected because it is a fundamental requirement for each person working in the refinery to be observant. However, 14 respondents (22%) did not know if they follow procedures as strictly as possible, while 12 respondents (19%) stated that they follow procedures very strictly. Only 7 respondents (11%) were clear that they did not strictly follow the procedures and 4 respondents (6%) reported that they followed the procedures a bit strictly.

Such a response is to be expected, because there are areas where data is to be collected as often as possible to make sure that safety is maintained. For example, the extractors, as well as the vessels which feed the raw materials, are supposed to be monitored as frequently as
possible. However there are tasks that are prone to ‘people going through motions’ such as the risk assessment simply because, being human, there are things that people take for granted.

Naturally, there are a lot of experienced professionals at the refineries, especially those that are employed for raw material mining and extraction as well as the gas sweetening plants. However, when experience is well above the norm, there can be tendencies towards complacency. Therefore, question 31 asked, ‘did you allow experience to overrule procedure, manuals and or checklists?’ It was a difficult question to admit to but one that it was necessary to ask because incidents in the industry have shown that when people are complacent with their actions, accidents follow, and that it is human nature to be complacent once there is over confidence in a system. In response, we see Figure 6-31 showing that only 27 respondents (43%) categorically said they were not complacent but 15 respondents (24%) did not comment. If the decision making was done by experienced people, then they are likely to use existing knowledge of the operations that they have gathered over the years; however, it cannot be easy to refer to such knowledge since it is intangible and relates to personality. A lot of experienced professionals did not comment on the question, while 12 respondents (19%) confirmed that they use experience to make decisions rather than the
manuals and procedures. However, 9 respondents (14%) did not know if their decisions were based on experience or manuals and check lists. They argued that there are certain manuals that become familiar such that one can operate an item without a manual. It is, therefore, possible for one to perform a task and be able to fill in the details after the task has been executed.

**Figure 6-31:** Does experience overrule procedure, manuals and checklists?

Question 32: How strictly do you abide by the standard procedures for using tools and instruments? This question was necessary to test the way respondents look at their level of adherence to standard procedures for using tools and instruments. There is a variety of tools and instruments that are necessary for collecting data and for adapting the operations in the refinery. It was vital to notice that 19 respondents (30%) strictly adhere to the rules for using instruments and tools; 16 respondents (25%) did not know if they are strict or not but they continue using the tools and instruments. 15 respondents (24%) were not very strict, while 9 respondents (14%) were very strict with the use of tools and instruments. Only 4 respondents (6%) were not strict at all (Figure 6-32).
The volatility of the product requires a constant use of instruments to take readings and make decisions as to how the process is working. However, most of the work is automated except for tasks that involve field work.

Field work not only involves the use of various tools, but also leads to a difficult physical environment for work. While the refinery may have designed facilities, the physical environment itself can be punishing for workers because of the processes that are necessary for production. Therefore, question 33 asked, ‘Does the physical work environment hinder the smooth operation of risk assessment?’ (See Figure 6-33).
Figure 6-33: Assessing if the physical environment is a hindrance to risk assessment?

Figure 6-33 shows that 31 respondents (50%) were hindered by the physical environment as they performed risk assessment. This means that, while the product processes are designed as ideal, there are difficulties for the workers to follow through all processes and be able to determine the risks as adequately as possible because of the physical environment. However, 14 respondents (23%) did not know if the environment was a hindrance, but 11 respondents (18%) stated that the physical environment was not a hindrance, while 6 respondents (10%) did not comment. Observations indicate that the physical environment was punishing for field workers as well as those that were responsible for the feeders and the changeover stages of the process. Any human intervention was considered taxing; however, the danger is that, if the physical environment is taxing, decision makers may ignore procedure so as to ease the work process.

Another human factor issue is the structure of the management in the work place. Question 34 asked respondents to state how they felt about management decision structure, and if it overrules technical decision makers. Technical productivity tends to have lean management structures but still they could be impacted on by human behaviour. In response, Figure 6-34 shows that 25 respondents (40%) believe that managers altered decisions, 22 respondents (35%) did not know if management altered their decisions. However, 9 respondents (14%) did not comment, while 7 respondents (11%) felt that the structure of management did not hinder or alter the decisions.
For an individual to be appointed in management he/she must have a vast level of competence and experience and that can be a sure way of reinforcing and or altering decisions. However, field workers and those experiencing front line risks could easily feel undermined. Consequently, alterations could become a source of discontent and discomfort to make decisions, resulting in indecision.

6.6.2 Religious factors

The remaining questions in section 4, part two were based on the belief that people could have a religious culture which promotes belief in divine intervention in incidents that are perceived as too grand for human control. In most Islamic countries, people are allowed to practice their religion because provisions are made in the work place for them to do just that.

Question 35 asked: ’Are work patterns in line with your religious beliefs?’ The question was meant to test the availability of time for people to work and still be comfortable with their religious standing. Figure 6-35 shows that 24 respondents (38%) felt that was the case, meaning that their pattern of work was in line with their religion. 19 respondents (30%) did not know if the pattern was in line with their religious beliefs, while 12 respondents (19%) felt work patterns were not in line with their beliefs. Only 8 respondents (13%) could not comment.
Even if the pattern of work can be in line with religious belief, the work place has to provide for an environment which can tolerate such a practice. Therefore, question 36 asked respondents to state if they were allowed to practice their religion even at work. Figure 6-36 shows that there is provision for practicing religion in the refinery for 29 respondents (46%) while 18 respondents (29%) did not know about such provisions. Only 13 people (21%) did not comment and 3 people (5%) categorically stated that the provision for their religion was not available (see Figure 6-36).
Provision of facilities to allow people to practice their religion is paramount in most areas of the Middle East, meaning that there is a culture of allowing workers to practice as and when there is a need. There is also a possibility that safety concerns may easily be relegated in the context of religious belief due to the perception that workers may have about occupational health and safety as well as the technical requirements to deal with risks.

It is for this reason that question 37 was designed to ask respondents if they even considered their safety and the safety of others to be necessary in their religion. As people practice what they believe in, it was vital to test how their perception of risk can be impacted because there are times when they have to leave the station of work to go to the prayer rooms, for example. In response, Figure 6-37 indicates that safety is paramount according to 38 respondents (60%), while 15 respondents (24%) did not know if that was the case. 7 respondents (11%) did not comment, while 3 people (5%) had a different view, choosing the option that safety was not an issue per se. Even though the safety code is not visible as people practice their beliefs, there is evidence of strict adherence to performance codes in most refineries in Kuwait because of the multi-cultural workforce.
There is no technical way of representing safety in one’s beliefs; however, there is a possibility that individuals could feel that their technical abilities can be supplemented by religion. With this in mind, question 38 stated, ‘Do you think prayer should supplement the adherence to technical procedures?’ Out of the 64 people that answered the question, only 27 respondents (42%) answered the question in the affirmative. 18 respondents (28%) did not know if that was the case, while 15 respondents (23%) did not comment. 4 people (6%) did not believe that was the case (Figure 6-38). It is normal practice to work on technical factors and supplement them with religious beliefs; however, some respondents may not easily find the link, although people with such a belief have to be allowed to work and be able to practice their religion. There is evidence that this is the case at the refineries, even though there is no inclusion of factors other than technically related ones in all risk assessment reports.
Could prayer supplement the adherence to technical procedures?

No comment: 15
Don’t know: 18
Yes: 27
No: 4

Figure 6-38: Could prayer supplement the adherence to technical procedures in the work place?

Literature in sections 2.0 and 3.0 shows that bias can be triggered by many factors; some biases could be human, others could be social and cultural. In Kuwait, society is mainly Islamic and has an Arabic culture hence the importance of religion. It was therefore important to assess the way respondents assessed themselves regarding the bias that they may have at the time of risk assessment with social and cultural factors in mind. Therefore, question 39 was designed as follows: ‘using a likert scale of 1 to 5, where 1 stands for “very low”, 2 stands for “low”, 3 stands for “moderate”, 4 stands for “high” and 5 stands for “very high”, rate the level of social and cognitive bias in the risk assessment process’.

The response, indicated in Figure 6-39, shows that respondents acknowledge bias, but to a moderate level because this is the highest score obtained from the survey at 44% (28 respondents). The second highest is the low level bias at 30% (19 respondents) and then the 9 respondents (14%) who felt that the bias was high. Only 4 respondents (6%) chose the “very high” bias while 3 people (5%) felt the bias was very low.

This response is in tandem with the other answers which indicated that the respondents felt that they were able to deal with risks associated with occupational health and safety even without technical procedures but by using experience. There is a belief that workers can continue practicing their way of life but that safety is paramount and that they have instituted
measures for training and support through social and cultural activities such as prayer rooms. However, bias at decision making is minimal but it could have a wider level of consequences.

![Graph showing the level of social and cognitive bias in risk assessment.](image)

**Figure 6.39:** Rating for the level of social and cognitive bias in the risk assessment process

### 6.7 Section Six: Adopting a Strategy to Promote Integrated Risk Assessment that Recognises the Social-Cultural Values of the Workforce

Section six of the questionnaire was designed to assess the perception of the strategies that could be used in the refinery to ensure that social and cultural values are integrated in the risk assessment process so as to enable people to participate fully in the assessment process. The idea was to gather information on perception about non-technical factors necessary to support the alleviation of risks associated with occupational health and safety for the workers in the refineries of Kuwait.

In question 40, respondents were given a statement, ‘Risk assessment processes could be introduced at social gatherings in an informal way’. In response, 32 respondents (51%) could neither agree nor disagree, while 13 respondents (21%) disagreed with the statement. The rationale behind the disagreeing was that there are technical processes that require one to be in a technical mode, as it were, in order to think seriously about an issue which is why 8
respondents (13%) totally disagreed with the statement. However, 10 respondents (16%) agreed with the statement, arguing that over the years technical ideas have been generated by the use of informal gatherings such as the promotion of ideas that are not necessarily implementable at the time of a social gathering (see Figure 6-40). This is a proven way of gathering information in risk assessment sessions and so it could work for the oil and gas refining plants of Kuwait.

![Risk assessment could be introduced informally at social-cultural events](image)

**Figure 6-40**: Risk assessment could be introduced informally at social-cultural events

Over a time period, risk assessors develop an understanding of the way people work; hence, they can then map the work culture with the decisions related to risk and the occupational health and safety. Therefore, question 41 asked respondents to state their opinion concerning the proposition that work culture could be used as a way of assessing compliance with risk assessment procedures at work. This means that the parameters of work culture that have been studied in the refinery could be set as a yardstick to measure compliance.

In response, Figure 6-41 shows that 35 respondents (56%) agreed with the proposition because they believe that each worker may have attributes unique to themselves and so it is vital that an assessment of compliance with procedures can be individualised as a tool for assessment. However, 14 respondents (22%) could neither agree nor disagree, while 7 respondents (11%) disagreed with the statement. Only 4 respondents (6%) totally agreed and
3 respondents (5%) totally disagreed. The argument is that, just as professional development auditing for the individual is evaluated on an individual basis, it might be ideal to introduce testing of compliance to risk exposure by ensuring that one’s work culture is mapped against the tools so that an individual’s measurement yardstick can be unique.

![Work culture could be used as a way of ensuring compliance with risk assessment procedures](image)

**Figure 6-41:** Testing the perception that work culture could be used as a way of ensuring compliance with risk assessment procedures

In question 42, respondents were asked to assess the proposition that it would be possible to strengthen risk assessment protocols using religious beliefs that teach the sanctity of life. It is possible to find dedicated workers that have good religious beliefs, but it is rarely the case that it can be integrated into templates for risk assessors to consider as part of the social and cultural attributes of the workforce. Figure 6-42 shows that 29 respondents (46%) could neither agree nor disagree with the statement, hence they were neutral. However, 18 respondents (29%) agreed with the statement, while 8 respondents (13%) disagreed. There were only 5 respondents (8%) who disagreed and 5 other respondents (8%) totally agreed with the statement. However, 3 respondents (5%) totally disagreed with it.

There was a perception that everyone could be subjected to the same scrutiny, yet the way different people work varies; however, the impact one could have is achievable with
teamwork. Therefore, religious beliefs, for those that follow key steps within their beliefs, could be used as a crucial step to position everyone with information about risk.

Figure 6-42: Could religious beliefs strengthen risk assessment protocol?

Another way of looking at it is to ensure that the management structure is integrated with the social positions that people have in society. Therefore, question 43 suggested that the management structure could be designed to allow for technical competence as well as social positioning of the workers to be recognised in decision making (see Figure 6-43).
Figure 6-43: Technical compliance and social positioning could be used in decision making about risk

The issue herein relates to the fact that some of the workers may not have much in terms of the position they hold in the firm; however, in society they could be an influential figure in dealing with social and cultural factors that impact on performance at work. Therefore, using such people to profile risks could be an ideal way to factor in such attributes within the risk assessment model. In response, Figure 6-43 shows that 28 respondents (44%) agreed with the statement; 19 respondents (30%) neither agreed nor disagreed. 9 respondents (14%) totally disagreed, while 5 respondents (8%) totally agreed with the statement. Only 3 respondents (5%) disagreed. While the idea in the statement was welcomed, the worry was that the implementation of social positioning could mean delving into the local community to assess who the representative should be; however, that person may not have the right permission to be operating in the oil and gas facility.

Question 44: The work environment could be allowed to integrate varied social-cultural and religious diversity. This statement allows for risk assessors to take time to examine the factors that are likely to destabilise or threaten the occupational health and safety harmony due to uncertain events. However, if the factors can be identified as social, cultural and religious in nature, the work environment could work out ways to integrate these factors so as to ensure safety for everyone.
Figure 6-44: Work environment could integrate social-cultural and religious diversity

Figure 6-44 shows that 27 respondents (43%) agreed with the statement, while 16 respondents (25%) neither agreed nor disagreed with the statement. 13 respondents 21% totally agreed, while 7 respondents (11%) disagreed. The main issue for the respondent is how to apply the concept considering there are workers who may not necessarily be expected to be religious or to fit into the society.

The current risk assessment tools are mechanical in nature, so any issue that deals with the social, cultural or religious views is seen as non-technical. However, with regard to the centre of the risk assessment that is linked to the occupational health and safety of the workforce and the integrity of the refinery, it is important to apply ‘anthropocentricism’ which implies that, for any work environment, anthropocentricism places humans as the most important issue above anything else. Hence, question 45 asked respondents to state their opinion about the proposition that if ‘people are at the centre of risk assessment, there is a high likelihood that the oil and gas installations in Kuwait could be very safe’. The response in Figure 6-45 shows that 25 respondents (40%) could neither agree nor disagree, while 23 respondents (37%) agreed with the statement. Only 6 respondents 10% disagreed with the statement while 5 respondents (8%) totally agreed with it; also 4 respondents 6% totally disagreed. The main difficulty comes in attempting to implement human centred factors in the risk assessment procedure as is the case in the aviation industry.
Anthropocentricism at the centre of risk assessment reduces incidents

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</tr>
<tr>
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<td>23</td>
</tr>
<tr>
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<td>25</td>
</tr>
<tr>
<td>Disagree</td>
<td>6</td>
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<tr>
<td>Totally disagree</td>
<td>4</td>
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Figure 6-45: Anthropocentricism at the centre of risk assessment could reduce incidents and protect the occupational health and safety of the workers

6.8 Summary

The perception of the influence of social-cultural values in the oil refinery varies from section to section; however, there is unanimity from respondents concerning the importance of recognising social and cultural values in the work place.
7. **CHAPTER SEVEN: PRESENTATION AND ANALYSIS OF RESULTS FROM TWO CASE STUDIES**

7.1 **Case Study A: Abdullah Refinery (KNPC 1)**

Historically, the oil and gas related environmental issues in Kuwait have taken centre stage, especially in the mid-1990s when the gulf war resulted in oil field fires with devastating environmental consequences (Kwarteng and Al-Ajmi, 1997). To date, Kuwaitis experience some difficult pollution-related environmental concerns attributable to the oil and gas industry. Over the last five years, incidents from the industry have occurred mainly because there has been a drive to increase investment in the sector (Chevron, 2009) and there has also been an increase in media awareness and reporting. Using both descriptive and exploratory case study techniques (section 5.8.1), it was possible to identify the Kuwaiti oil refinery that had an accident on the 1st October 2011 as a target case for this research. Anecdotal evidence from Kuwait tabloids was crucial in the identification of the case herein called “A” which allowed this study to engage the workforce on health and safety matters in the refinery.

The main rationale for using interviews in case studies (section 5.7.5) was to ensure that the following four main issues set out under the research objectives (section 1.4) could be explored: (i) to assess any indication of the factors that could relate to how “the psychology of risk is taken into consideration within the oil refineries’ work environment in Kuwait”; (ii) to explore the possibility of issues relating to the “pressure that lean management wields on technical risk assessment processes” at the refinery level; (iii) to examine any “technical approaches to integrated health and safety risk assessment in the oil refinery”; and (iv) to “assess the impact of the social-cultural environment on the technical application of risk assessment” considering that the refinery has a multi-cultural workforce. Using a stratified sampling technique, permission was granted to issue a set of questions for discussion at two main oil and gas installations in Kuwait, namely: (i) Abdullah Refinery (KNPC 1) and (ii) Ahmadi Refinery (KNPC 2).
7.2 Detailed Information on Case Study A: Abdullah Refinery (KNPC 1)

7.2.1 Operational Factors Relating to Psychology of Risk
Operational environmental problems have been top of the list in Kuwait. Accidents from the oil and gas processes have been observed over the years; however, the health and safety systems were considered adequate and in line with technical practice in the industry. The interviewees indicated that the processes of risk assessment are rigorous, though they cannot prevent all accidents. The issue with oil and gas operations is that, because data has to be collected from the systems, where there is a problem the team is able to make repairs. There is a drive to implement preventative risk assessment; however, there are problems with the infrastructure and thus with the sources of accidents that could lead to further environmental damage. The drive, as far as risk assessment is concerned, is towards the operational integrity of the installations. Therefore, monitoring is centred on equipment and systems, including the process of taking stock of the data. There is no policy on how the risks can be rated or the influence that human psychology could have on the actual process.

7.2.2 Evidence of Pressure from Lean Production at Refinery Level
The issue of applying “lean” production was considered in the light of the accidents that were reported within the industry (Kuwait Times, 2012). Even though incidents were not specifically linked to the refinery, it was vital to assess the impact of lean production on health and safety risks. From the interview, it was clear that lean production is not clearly applied from the lean perspective; rather, it is seen as a strategy for lowering operational costs. This implies that lean production is not necessarily planned in a direct way; indirectly, the approach lean is planned as a way of ensuring that each unit can reduce costs as they operate. This strategy is clear and effective because every unit assesses the budget at stipulated time intervals.

The interviews show that there is no link between lean production and safety risks in the operation. The interviewee understood that if costs were cut too greatly, accidents could materialise because the overhauling of equipment could be delayed. However, there was no policy of linking such actions to the potential risks that it could exert on the refinery.
7.2.3 Evidence of Integrating Health and Safety Risk Assessment
A typical oil refinery has various processes taking place during any given minute and so it is reasonable to expect that health and safety risks might have to be integrated in order to allow for a holistic approach to their eventual management. From the interviewees, it was clearly noticed that risk assessment is technically implemented at each section; however, only the strategic managers (directors) receive data from all sections. There are no deliberate policies to integrate risk assessment so as to provide lessons for each unit; however, when an incident materialises, the response can be holistic. For example, Ud-Din et al. (2008) reported on the electronic systems for tracking contamination. This is in line with the warning systems that are sent to people about the toxicity of gases, water and other areas in which there can be environmental concerns or discharges. Such a system, and many alike, are essential for operating an oil refinery; however, they are not integrated at operational levels to assist the decision making process. The manifestation of accidents at refineries was used to prompt discussions that could be contextualised for the case study.

7.2.3.1 Discharges to Water and the Impact on Aquifers
There is evidence that the refinery responds to the need for protecting the fresh water aquifers because of public concern (JCC News, 2009; KUNA, 2012). However, there is no link between risks to refinery operation and the response strategy to discharges. The issue relates to the visibility of the discharges, meaning that if the discharge is visible it tends to be dealt with immediately otherwise the issue can drag for some time.

7.2.3.2 Discharges to Air and the Impact on Air Quality
There is a good response towards risks associated with discharges to air because of government policy (KUNA, 2012a). One could argue that because of the visibility of air pollutants more effort is applied to the management of risks. However, actions under air pollution risks are not linked to other discharges such as to the sea or water aquifers.

7.2.3.3 Discharge to the Sea
For the Abdullah Refinery (KNPC 1) interviewee, the risk assessment strategy leading to the prevention of discharges to the sea is not necessarily linked to the main risk assessment
process as it is performed by the environmental quality team. Anecdotal evidence points to
the argument that incidents of discharge to the sea are as bad as those to the air. For example,
Arabian Times Online (2012) reported that “according to Kuwait National Petroleum
Company (KNPC), oil leakage at a tanker 100 meters away from the Fahaheel beach has
affected the sea area, reports Al-Rai daily quoting the Assistant Director General of
Environment Public Authority (EPA), Captain Ali Haidar. In a statement, Captain Haidar
stressed that preliminary results indicate the leakage is due to high sea pollution, but the
Ministry of Communications represented by the Marine Survey Department has opened
investigations to determine the cause, even though leakage at the tanker has stopped. Sources
said many areas in Ahmadi were polluted Thursday and Friday night, and citizens of the area
blame Kuwait Oil Company (KOC) officials for the air pollution, saying they are not serious
on resolving the problem. This is another example of a lack of an integrated approach to
health and safety risk assessment in the refinery.

7.2.3.4 Discharge to Land
The interviewees were asked about what reaction they would have in the event that their
refinery was to discharge to land, as has been happening over the years in Kuwait. For
instance, past incidents caused biological damage to the species found in areas where oil is
being recovered (Al-Hashem, 2011). This is an on-going problem especially where there are
chances of increasing the heavy oil recovery by international firms like Chevron (2009). The
response indicates that the refinery has no integrated risk assessment for such a scenario,
meaning that each issue unit is assessed on its own merit.

7.2.4 Occupational Health and Safety Lessons from Incidents within the Oil and
Gas Industry of Kuwait
With a multi-cultural workforce at any refinery, it was important to assess any impact that
could be felt due to the social-cultural environment at times of application of technical risk
assessment in the production process. The issues raised included the main source of templates
used for risk assessments and how these have been used by the workforce at operational
level. In response, it was clear that, at the refinery level, the exposure to risks is largely
dependent on the reliability of the refinery and the maintenance programs that they operate.
There is no deliberate policy to allow for any differences in the way different workers might
perceive health and safety risks, or how the workforce could interpret the meaning of risks. At the refinery, social and cultural issues are inconsequential to the risk assessment process.

7.3 Case Study B - Ahmadi Refinery - KNPC 2.

7.3.1 Testing the Influence of Psychology of Risk in Operations at the Ahmadi Refinery

The starting point for the interviews relating to the second case study was the existing mechanisms for responding to health and safety incidents in the work place. For instance, they recorded an incident in 2011 at a service drain tank in the Large Scale Pilot (LSP) (Chevron) plant. On Friday October 27, 2011 Steam Flood operations circulated diesel fuel through steam generators in order to fill the system and check for leaks. At approximately 5:30pm diesel was observed spilling from the normal service drain tank at LSP onto the ground and out towards the production field. Operators investigated and found a valve open on H-201 which turned out to be the drain valve from the generator fuel line to the normal service drain tank. As a result, the service drain tank overfilled and caused the spill.

There was no indication from the operations manager that the incident could have been linked to the perception of risks by the workforce; rather, it was clear that their way of dealing with risks was through laid down procedures. If, however, risks materialise they tend to be thoroughly investigated, and the major issues faced were largely due to technical failure or human error. It could be argued, in this example, that human error was more to blame than the issue of psychology of risks; hence the perceptions of risks from the workforce tends to be discounted in the process because the procedure does not allow for it.

7.3.2 Evidence of Pressure on the Use of Lean Management

The response to the application of lean management by interviewees on this case was very similar to that found in case study A. Lean production is rarely seen as an inevitable process for reducing waste but rather as a cost cutting measure so that the expenses can be reduced. It was also observed that lower level operational staff were not involved in budgeting for their units and so the process of minimising unnecessary costs was handled by middle managers or operational management teams. Another key factor was the link between costs and the market dynamics for oil and gas; as a response to market information, team leaders were constantly
informed about the anticipated output over a steady time-period (fortnightly) in order to use the figures in the forecasting of operational expenses. At times, when the anticipated return was considered to be low, there was pressure to reduce operational expenses; however, in times of high market value for the products, there was no pressure to minimise operational costs. It can, therefore, be argued that, unless an incident materialises, there tends to be no clear link between any pressure the refinery may have on lean production and its possible impact on risk assessment processes. The rationale for such an argument is that, for as long as incidents do not materialise, it is difficult to assess the impact of lean processes on health and safety. For instance, when there is an accident or failure in the refinery process, investigations often lead to faulty detection systems or worn out parts and so the weakness in such a case relates to risk prevention.

7.3.3 Evidence of the Integration of Health and Safety Risk Assessment Practices at all Levels of Management

Interviewees were asked to evaluate the level of integration of health and safety risk assessment practices within the refinery considering that the processes have many elements to them that are linked in many ways. Reference was made to previous accidents. In response, there was evidence that even though the risk assessment practices may vary at each operational level, the refinery deals with accidents in a swift way because of the high level of integration within management. For instance, they argued that if an incident causes some unit to have to shut down fire and security departments of the organisation are informed. The thrust of the argument about incidents is that operations tend to run smoothly; however, there could be an inherent problem with the plant such that components or elements could fail. In such an event, there can be no clear plan as to the actual impact of the situation and or the hazards it could pose, but a quick response is anticipated. Table 7-1 below shows the various people involved in such an issue and how the management team communicates to ensure that the incident can be resolved.

The response to incidents works like “military drills” where every worker is made aware of steps to take as and when they get a signal that operations are not going well. This shows a high level of integration for their operations. However, laxity is possible if, for example, the workforce ignores warning signs due to the monotony of “drills”; therefore, the way each unit practices risk assessment is not fully integrated even though the response to any incident is fully integrated.
Table 7-1: Management structure and communication mechanism for incidents

<table>
<thead>
<tr>
<th>Management Structure</th>
<th>Unit A</th>
<th>Unit B</th>
<th>Unit “n”</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Risk Facilitator</strong></td>
<td>Head of Division</td>
<td>Operations Manager</td>
<td>Health and Safety Manager</td>
</tr>
<tr>
<td><strong>Team Members</strong></td>
<td>Workforce</td>
<td>Workforce</td>
<td>Workforce</td>
</tr>
<tr>
<td><strong>Organisations</strong></td>
<td>In-house; Local Authority; Fire services</td>
<td>In-house; Local Authority; Fire services</td>
<td>In-house; Local Authority; Fire services</td>
</tr>
</tbody>
</table>

### 7.3.4 Evidence of the Impact of Social-Cultural Factors in Risk Assessment Practices at all Levels of Management

Oil and gas refineries in Kuwait employ a multi-cultural workforce. From Table 7-1, it can be seen that there is a variety of employees from different global cultures working in various organisations and consequently the response to risk can vary. Oil and gas refineries manifest what Kouabenan (2009, p767) referred to as an “era of globalisation where workers from different backgrounds are relocating, and increasingly complex technology is being exported”, and “different factors are seen to cause bias in accident explanation and risk perception”. Take, for instance, the investigation process for incidents; many professionals are employed so that they can guarantee the integrity of the production as well as capturing indicators that can help in the identification of faults. Evidence from the accident of October 2011 shows that workers did not realise that their action in leaving the valve open on the drainer fuel system to the generator could have an impact on the overall operations of the system. However, no one could tell if the actions of the workers were linked to their social-cultural tendencies in the work place.

Secondly, there were indicators of the malfunctioning system but the workforce did not easily detect it even though the alarm system was flashing. Not until the tank levels started dropping did they notice a problem with the system. There were clear indicators from the continuous high alarm on the display from the previous day but it took a long time for the normal service drain tank pump to be found and to check that it was operating normally, yet no levels were identified based on pump condition.

From the transcript of the accident it can be seen that there were indicators for the potential hazard and that it posed a threat to the safety of the workers, the plant and the investment in the system but the ground workforce left it because they had no visual contact with the source.
of the problem. One could argue that using a single incident, it is difficult to see how the social-cultural factors could be useful to the process of risk assessment.

Naturally, there is a strong perception in the industry that belief systems, culture and accident prevention are intertwined (Kouabenan, 2009), meaning that how people perceive risks and or how they deal with the sources of risks is largely influenced by their beliefs and their culture. Hence Kouabenan (2009, p767) opined that “an understanding of the beliefs people hold about risks and the causes of accidents, as well as their perceptions of risk targets and the need for safety, are important prerequisites for effectively managing risk and designing preventive measures”. This statement could not be proven from the case study because interviewees believed that, as long as the procedure was followed, they could not necessarily blame an incident on an individual; rather, they would rather attribute it to human error or misjudgement from the teams operating the facilities. This implies that the teams were not linking or allowing any social-cultural factors to affect the risk assessment process.

7.4 Summary
The information gleaned from the two case studies may indicate that there are differences in the perception of risks within the work environment by various people working at different levels of the organisation within the refinery set up. The response suggests that, while it might be normal for oil and gas facilities to have a globally diverse workforce with a diverse mind set regarding the perception of risks (Mearns and Yule, 2009), refineries strive to unify the approach to risk assessment by ensuring that they adopt standard templates. The use of such standard templates could suggest how invaluable they are to the risk assessment protocol in terms of integrating a plausible response to accidents; however, the deployment of standard approaches may not be as “standard” in reality because human error may not be accounted for in the use of standard approaches. The response from the two case studies could also suggest that making the production process lean could be used as an inducement for teams in times of tight budgets, but lean operations are not necessarily seen as a threat to operations until there is an accident whose cause can be linked to cost cutting. Ordinarily, it could be argued that the workers felt that they were experienced enough to manage operations and that they were sure that the integrity of the system could not be breached or that the warning systems were central to the integration of health and safety response to incidents. However, it could be argued that the level of integration for health and safety risks may be primarily attributable to the “mechanical” integrity of the systems and less to the way
operators (workforce) conduct themselves amidst the cultural diversity of the workforce. It was plausible to see varying levels of perception towards health and safety risks at each stage; for instance, some workers were more conversant with the operations of the oil and gas organisation while others were stronger in their perception of risks from their own culture. However, their varying perceptions about the impact that social-cultural values may have on the process of health and safety risk assessment may not be captured using the current methods. For instance, it was observed that the workforce that had management positions were more inclined to use a formal risk assessment mechanism to establish the problem, the causes of the problem and how the risk exposure could be dealt with so that the operations could run smoothly. On the contrary, those with fewer positions of responsibility were more inclined to avoid a formal risk assessment processes.

It could be argued that capturing the varying levels in the approach to risk assessment could be essential in the establishment of how social and cultural factors have been estimated (or otherwise) by the oil and gas facilities in the oil and gas industry in Kuwait, or else it could be difficult to integrate perceptions of risk from the social-cultural perspective within the existing technical systems with a view to developing a model that could incorporate social-cultural factors in the risk assessment process. Such an effort may lead to a sure way of incorporating what people think about hazards in their operational zones, as well as perceptions of the integrity of the oil and gas facilities.
8. CHAPTER EIGHT: DISCUSSION AND THE DEVELOPMENT OF A FRAMEWORK FOR A SOCIAL-CULTURAL INTEGRATED RISK ASSESSMENT MODEL

8.1 Introduction
Before proposing an ideal framework for the integration of social and cultural values in the risk assessment process that could improve the health and safety records for the oil and gas refineries in Kuwait and the MENA region, it is important to reflect on the research hypotheses that were proffered at the beginning of the research (see section 1.5).

This section, therefore, discusses the outcome of the primary data collection and analysis, including the validation exercise performed in oil refineries in Kuwait, Saudi Arabia, Qatar, Oman and Dubai (the UAE in general). At the time of the validation exercise, there was no response from the North African region due to the security concerns of the companies operating the refineries; however, most operators of refineries had installations in the UAE, Kuwait and Saudi Arabia, hence they were able to send results from these locations.

8.1.1 Testing of Hypothesis One
The first hypothesis stated that social-cultural perceptions of hazards do not influence the current health and safety risk assessment techniques in oil refineries

a. Dependent variable (DV): current risk assessment techniques. This implies that the current risk assessment techniques (DV) used in the oil refinery depends on the social-cultural perceptions of hazards in the work place. Meaning that when risk assessors incorporate the social-cultural perceptions (IV) of hazards they can influence the

b. Independent variable (IV): social-cultural perceptions of hazards. This implies that the social-cultural perceptions of hazards are independent, and that risk assessors perception have the possibility impacting the approach to risk assessment that is used in the work place.

c. Group: oil refinery workforce in Kuwait
The hypothesis was split in two: the Null Hypothesis (H₀) and the Alternative Hypothesis (H₁)

The Null Hypothesis (H₀) states that “social-cultural perceptions of hazards do not influence the current health and safety risk assessment techniques in oil refineries”.

The Alternative Hypothesis simply reverses the Null Hypothesis to suggest that there is considerable influence of social and cultural perceptions on the technical risk assessment processes for health and safety in the oil refineries.

Alternative Hypothesis (Hₐ) states that “the social-cultural perception risk in the workplace of the hydrocarbon facilities have been influencing by the technical risk assessment processes”.

For the research to deal with data that can be applied to the hypothesis, it has to use a likert scale which offers a “categorical type of data that can be assessed using a chi-square technique” (Black 2010, p643). The mathematical equation for the chi-square test of association between variables is shown here in equation 8-1, whereby the association can be measured between variables or independence can be established between the variables (Sounderpandian, 2008).

\[
X^2 = \sum_{i=1}^{r} \sum_{j=1}^{c} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}
\]

Equation 8-1: The mathematical model for chi-square test of independence or association (Sounderpandian 2008, p672)

Therefore, the test of independence or association of the categorical scores for variables from a question can be obtained based on the degrees of freedom (df): multiplication of a row minus 1 with a column minus 1, as shown in equation 8-2 below.

\[
df = (r - 1)(c - 1)
\]

Equation 8-2: The degrees of freedom of the chi-square statistic test (Sounderpandian 2008, p672)
Using a stratified sampling technique, permission was granted to issue a set of questions for discussion at four main oil and gas installations in Kuwait, namely: (i) Abdullah Refinery (KNPC 1); (ii) Ahmadi Refinery (KNPC 2); (iii) Maim Gathering Center Plant (KGOC 1) and (iv) Pressure Maintain Plant (KGOC). The justification for the use of stratified sampling is that the research needed to use respondents that are involved in the risk assessment processes in Kuwait. Note that the hydrocarbon installations are not similar. They have unique characteristics; however, they are unified by the risk assessment processes they undertake during their operations. The target sample (n) was 100 respondents from the four hydrocarbon installations within Kuwait. A total of 117 people participated over a period of 2 months. All the 117 respondents were asked in question 40 of the interview to state if they considered the social-cultural perceptions of hazards when they undertook the following risk assessment processes of (i) risk identification; (ii) risk estimation; (iii) risk evaluation and (iv) risk treatment (see Figure 8-1).

![Diagram](image)

**Figure 8-1:** Summary of the set of questions used in the interview based on the questionnaire template (Appendix A)
The rationale for the question was to provide an opportunity for the interviewees to state their position regarding the consideration of social-cultural factors with the stepwise approach to risk assessment. It was a more direct question that was necessary for testing hypothesis 1.

Using table 8-1, it is possible to calculate the parameters needed for assessing the level of association of independence on the profile of the response to the hypothesis. The level of significance, \( \alpha \) at 0.05 and the degrees of freedom \( [v] \) were determined using the formula \((r-1)(c-1)\), where ‘r’ and ‘c’ stand for number of rows and columns respectively (Table 8-1). Hence, the degree of freedom \( [v] = (4-1)(4-1) = 9 \). Using the \( X^2 \) distribution table, the critical value works out to be 16.919 (Stephens, 1999). The chi-square statistic is 14.6314. The P-Value is 0.101572. The result is not significant at \( p < 0.05 \). The implication is that the Null hypothesis cannot be rejected which means that as far as the workforce is concerned, they do not see the significance of the social-cultural perceptions in the risk assessment processes of the firm. The results from the chi-test show that the profile is not any different between the various refineries, meaning that there is not enough evidence to conclude that there are differences between the outcome percentage profiles at the 0.05 level of significance.

**Table 8-1: Aggregate of the results from the chi-square test of independence**

| SOCIAL-CULTURAL CHARACTERISTICS (Beliefs, practices, rituals, customs, ideas) | RISK PROCESSES |
|---|---|---|---|---|
| | risk identification | risk evaluation | risk estimation | risk treatment |
| Maim Gathering Center Plant (KGOC 1) | 67 | 57 | 53 | 57 |
| Ahmadi Refinery (KNPC 2); | 48 | 68 | 73 | 62 |
| Abdullah Refinery (KNPC 1) | 34 | 37 | 47 | 56 |
| Pressure Maintain Plant (KGOC). | 41 | 46 | 59 | 65 |

For the Null hypothesis to be rejected there needs to be evidence that respondents were for the idea that, indeed, social-cultural perceptions could have an impact on the risk assessment
processes and techniques at work. The implications of the result is that if there is a fault in the risk assessment process that could be triggered by non-technical sources such as the way people relate to each other or by their work culture it would be difficult to isolate and confidently apportion the “cause and effect”.

In the validation exercise, a template with four main findings was sent to operators of various refineries in Kuwait, Saudi Arabia, Qatar, Oman, Dubai and Abu Dhabi. Table 8-2 shows the response obtained from the exercise. It took over 4 months to get the high response from the operators in the aforementioned countries. A total of 74 responses were obtained from more than 200 requests from various operators.

Table 8-2: Validation exercise for the research from 6 countries within the Mena Region

<table>
<thead>
<tr>
<th>Sample Name</th>
<th>Country</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample A</td>
<td>Kuwait</td>
<td>12</td>
</tr>
<tr>
<td>Sample B</td>
<td>Kuwait</td>
<td>9</td>
</tr>
<tr>
<td>Sample C</td>
<td>Saudi</td>
<td>13</td>
</tr>
<tr>
<td>Sample D</td>
<td>Saudi</td>
<td>8</td>
</tr>
<tr>
<td>Sample E</td>
<td>Qatar</td>
<td>11</td>
</tr>
<tr>
<td>Sample F</td>
<td>Oman</td>
<td>6</td>
</tr>
<tr>
<td>Sample F</td>
<td>Dubai</td>
<td>7</td>
</tr>
<tr>
<td>Sample G</td>
<td>Abu Dhabi</td>
<td>8</td>
</tr>
</tbody>
</table>

Validation question 1: The recent research shows that oil refineries in the region have been ignoring social and cultural perceptions when undertaking risk assessments for health and safety in the work place. Would you agree with this statement? Respondents were given three options: (i) Yes; (ii) No and (iii) Not sure.

In response, Figure 8-2 shows that the respondents approved the result by about 73% overall which causes a dilemma with regard to the low margin of difference in the chi test result. It
means that the respondents from Kuwait were not willing to admit the lack of involvement of the social and cultural values, but the results for the test prevailed and have been backed up in the validation exercise.

Validation Question 1: Recent research shows that oil refineries in the MENA Region have been ignoring social and cultural perceptions when undertaking risk assessments for health and safety in the work place. Would you agree with this statement?

Figure 8-2: Validation Question 1: ‘The recent research shows that oil refineries in the region have been ignoring social and cultural perceptions when undertaking risk assessments for health and safety in the work place. Would you agree with this statement?’

When you consider section 4.6 to section 4.8 of this dissertation, it is possible to observe that the result of hypothesis 1 is in line with the literature on how health and safety risks are dealt with at the industry level. In short, there is an emphasis on procedures and approaches, based on the standards for occupational health. However, literature shows that due to “social desirability” (SD) there is a tendency by people to deny socially undesirable traits or behaviours and to admit socially desirable ones” (Randall et al., 1993, p186), meaning that individuals could be forced to behave in a socially or culturally desirable manner even though it can be unsafe.
Therefore, companies also tend to use their own standard procedures to process the health and safety risks in the work place. As these standards are used, there is no room for asking how social and cultural values of a risk assessor can impact on the outcome. And this is a sensitive and serious issue as far as health and safety risks are concerned. This confirms the Pavlov’s Dogs theory in section 2.8 that health and safety risk assessors are conditioned to respond to technical procedures because they rarely consider the social and cultural values as they proceed to assess health and safety risks. This is why the Editorial (2009a) and Call (et al., 2003) reasoned that the psychology of conditioning has played a key role in the explanation of the way people become used to the conditions such that their response can be limited to the reflexes they have learnt.

8.1.2 Testing of Hypothesis Two
The second hypothesis stated that “applying lean management in oil refineries with a diverse workforce that uses a second language weakens risk assessment processes” (section 1.5).

a. Dependent variable (DV): robustness of the risk assessment processes depends on the application of lean management (IV)

b. Independent variable (IV): application of lean management is an independent variable and that it could set the strength of the risk assessment processes (DV)

c. Group: oil refinery workforce of Kuwait

There are many elements of lean management, therefore, two questions were used do deal with the hypothesis: (i) asking the respondents to rate the application of lean management in risk assessment processes and (ii) how the respondents rate the level of social and cognitive bias in the risk assessment process. Using a likert scale of 1 to 5, where 1 stands for “very low”; 2 stands for “low”, 3 stands for “moderate”, 4 stands for “high” and 5 stands for “very high”, respondents were asked two crucial questions.

The same stratified sample from the four main oil and gas installations in Kuwait were used. These were (i) Abdullah Refinery (KNPC 1), (ii) Ahmadi Refinery (KNPC 2), (iii) Maim
Gathering Center Plant (KGOC 1) and (iv) Pressure Maintain Plant (KGOC). All the 117 participants were asked:

(i) To rate their application of the lean principles when they are performing their risk assessment at work (see Table 8-3). (The columns from Table 8-3 have been abbreviated so that the table could fit the required paper format). Table 8-3 comprises Waste and Efficiency (W&E), Planning and Control (P&C), Customer focus (C-F), Continuous Improvement (C-I), Cooperative Relationships (C-R) and System.

**Table 8-3: Rating for application of lean management principles in risk assessment processes**

<table>
<thead>
<tr>
<th>Rating</th>
<th>W&amp;E</th>
<th>P&amp;C</th>
<th>C-F</th>
<th>C-I</th>
<th>C-R</th>
<th>Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>3</td>
<td>47</td>
<td>15</td>
<td>23</td>
<td>51</td>
<td>21</td>
</tr>
<tr>
<td>High</td>
<td>37</td>
<td>29</td>
<td>37</td>
<td>34</td>
<td>38</td>
<td>25</td>
</tr>
<tr>
<td>Moderate</td>
<td>17</td>
<td>19</td>
<td>12</td>
<td>14</td>
<td>18</td>
<td>32</td>
</tr>
<tr>
<td>Low</td>
<td>43</td>
<td>13</td>
<td>42</td>
<td>26</td>
<td>7</td>
<td>31</td>
</tr>
<tr>
<td>Very Low</td>
<td>16</td>
<td>5</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Black (2010) explains that determination of the relationship or difference between profiles of observed data can be done using the chi-square distributions, which are a family of distributions that take only positive values and are skewed to the right. A specific chi-square distribution is specified by giving its degrees of freedom. The chi-square test for a two-way table with r rows and c columns uses critical values from the chi-square distribution with \((r - 1)(c - 1)\) degrees of freedom. The P-value is the area under the density curve of this chi-square distribution to the right of the value of the test statistic.

Null Hypothesis \(H_0\) states that there is no relationship between the row variable and the column variables; the Alternative Hypothesis \(H_1\) states that there is some relationship but does not say what kind. Based on the observed scores in Table 8-3, a chi-square test of association using a 0.05 level of significance resulted in a critical value more than 31.41. This means that there are differences among the outcome percentage profiles at the 0.05 level of significance.
The hypothesis that applying lean management in oil refineries with a diverse workforce that uses a second language weakens risk assessment processes was not clearly answered using the percentage profiles after testing the level of association. In other words, the result from the chi-square test of association has indicated that the applications of lean principles in the hydrocarbon risk assessment exercises are varied in nature and that there is no consistency in the way they are being applied. Based on this result, it can be inconclusive to indicate that lean management weakens risk assessment processes.

Therefore it was important to aggregate the response as shown in Figure 8-3 where the highest recorded application of lean production was at detailed planning and control as well as cooperative relationships. This implies that when the refinery is performing detailed planning and or cooperation works with others there is a high likelihood that they are expected to apply lean production; and by so doing there could be signs of weakening the risk assessment.

On average, the application of lean processes is high throughout the operations; however, it is moderate when it comes to a focus on customer requirements. The nature of the industry is such that the customer is related not only to the intended user of the products but also the contractors employed to operate the refinery.

![Figure 8-3: Aggregate data for hypothesis 2](image_url)
As part of the hypothesis testing, respondents were also asked to state their level of bias due to social and cognitive factors so as to perform a chi-test on the response as shown in Table 8.4. Based on the observed scores in Table 8-4, it was possible to test how the respondents rate the level of social and cognitive bias in the risk assessment process. A chi-square test of association using a 0.05 level of significance resulted in a critical value of less than 21.03. This means that there was no difference between the outcome percentage profiles at the 0.05 level of significance.

**Table 8-4: Rating for cognitive and social bias during risk assessment**

<table>
<thead>
<tr>
<th>Rating</th>
<th>KPNC1</th>
<th>KPNC2</th>
<th>KGOC1</th>
<th>KGOC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>9</td>
<td>14</td>
<td>17</td>
<td>11</td>
</tr>
<tr>
<td>High</td>
<td>5</td>
<td>9</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Moderate</td>
<td>7</td>
<td>4</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Low</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Very Low</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
</tbody>
</table>

It could be argued that there is a link between individual behaviour and the way people undertake risk assessment exercises. In other words, there could be some level of cognitive and social bias. Therefore, the interaction of risk assessors, lean managers and the general workforce becomes extremely important in the successful implementation of a lean hydrocarbon process without negatively impacting on the reliability and safety of installations.

It could also be argued that, unlike technical risk assessment, ignoring the social-cultural and psychological initiatives in the processes could have a negative impact on the safety and integrity of hydrocarbon installations.

Validation question 2: The recent research has indicated that oil refineries are applying lean management as a cost cutting technique; hence they are endangering installations as well as the people that work in them from health and safety risks. Would you agree with this statement? They were given three options: (i) Yes; (ii) No; and (iii) Not sure.
Figure 8-3 shows that 64% felt that cost cutting was a real problem, and it was in line with part 1 of the hypothesis. However, there were pockets that felt that lean production was necessary to keep costs as low as possible without compromising on safety.

![Validation question 2: Recent research indicates that oil refineries are applying lean management hence they are endangering installations as well as the people that work in them from health and safety risks. Would you agree with this statement?](image)

**Figure 8-4:** Validation question 2: The recent research has indicated that oil refineries are applying lean management hence they are endangering installations as well as the people that work in them from health and safety risks. Would you agree with this statement?

The results from testing hypothesis number two tally with the causes of most accidents in the oil and gas industry. Literature on lean management under section 3.3 shows that, while the theories of lean production can be applicable to the industry (Pheng and Fang 2005; Al-Sudairi, 2007), reality shows that it has been used as a tool for cost cutting in operations to save money. For example, Lean (2010) explained that weak risk assessment procedures and cost cutting measures are crucial reasons for most incidents in the industry. Cost measures are therefore seen as a major issue in maintaining safety in the work place but the issue is always complicated because the company needs to operate efficiently without much waste (Meiling et al., 2012, p141) as the literature in section 3.3 indicates, but the difficulty is that in reality companies find it too complex to apply. In the case of Venezuela, lack of funding to the oil
refineries meant that shortcuts were made in the maintenance processes with catastrophic results.

8.1.3 Testing of Hypothesis Three
The third hypothesis stated that “undertaking risk assessment in oil refineries where a diverse workforce uses a second language reduces the instances of incorporating the psychology of risk” (section 1.5)

a. Dependent variable (DV): instances of incorporating the psychology of risk are reduced when the risk assessors undertaking (IV) their work in a diverse work place environment.

b. Independent variable (IV): Undertaking risk assessment is independent; however, if its taking in a refinery with a diverse workforce that uses a second language it can reduce the instances of incorporating psychology of risk (DV).

c. Group: oil refinery workforce of Kuwait

For hypothesis 3 to be tested it was vital that the term “psychology of risk” was broken down into cognitive and social desirability bias as earlier alluded to in section 3.5 of this dissertation. It has been clarified under section 3.5 that the word ‘bias” has been described as “a strong feeling in favour of or against one group of people, or one side in an argument, often not based on fair judgement” (Oxford Advanced Learner's Dictionary, 2011). The bias under consideration herein has to do with being “connected with mental processes of understanding” – herein called cognitive. Cognitive bias has been one of the fundamental reasons for judgment flaw when it comes to technical reasoning and or decision making such as risk assessment because a biased analyst may ignore evidence and follow their “gut feeling” about things that could otherwise be interpreted differently (Kahneman and Tversk, 1972). There are many areas of professional specialisation where people may believe that biases are difficult to come by because, on average, the data used would even out over a time period, reported Oechssler et al. (2009). The other key source of bias is “social desirability” (SD), which is widely understood to be the tendency by people to deny socially undesirable traits or behaviours and to admit socially desirable ones” (Randall et al., 1993).

Therefore, question 28 was ideal for testing “cognitive” bias since it was concerned with the “gut feeling”, while question 29 was ideal for testing social desirability. The explanation in
Section 6.5 says that “question 28 was about the perception concerning the influence these factors may have. The question stated that “Using a likert scale of 1 to 5 where 1 stands for “Highly unlikely”, 2 stands “Unlikely”, 3 stands for “Not Sure”, 4 stands for “Likely” and 5 stands for “Most likely”, what is the likelihood that you would be influenced by your social-cultural “gut feeling” when making technical decisions?” In response, the highest score was recorded from the 25 respondents (40%) who were not sure if their attributes could impact on their technical decision making, and the second highest score was recorded from 18 respondents (29%) who selected the ‘likely’ option. However, 9 respondents (14%) stated that it was ‘unlikely’, while 7 respondents (11%) selected the ‘highly unlikely’. However, 4 respondents (6%) selected the most likely choice.

Question 29 was more direct because it asked respondents to state what they could do in a specific situation. It asked, ”When faced with a decision related to risk, would you decide based on technical information even though it would go against your personal beliefs? The importance of recognising someone’s beliefs in the work environment cannot be over emphasised”. Using a descending order, 24 respondents (38%) were not sure if they could rely solely on technical data alone without any influence from personal opinion or beliefs. However, 18 respondents (28%) stated that they would most likely rely on the technical data compared to personal beliefs. 9 respondents (14%) selected the choice that it was highly unlikely for them not to ignore social and personal beliefs; 5 respondents (8%) said it was unlikely, while 8 respondents (13%) felt that it was likely for them to ignore personal beliefs.

The third hypothesis also meant that the “psychology of risk” was an amalgamation of social, cultural and religious beliefs attributable to the risk assessor. It was, therefore, important to use the Pearson correlation coefficient to perform a comparison between responses for various parts of the questions. According to Webb and Copsey (2011, p441) the Pearson correlation coefficient compares the degree of linearity between two questions with a list of variables that they may have used to collect scores. The result of the comparison calculation ranges between positive one (+1) if there is a positive correlation and a negative one (-1) if there is a negative correlation. Equation 8-3 summarises the mathematical model needed to perform the correlation; however, the Microsoft Excel function of “correl” performs the comparison (Microsoft, 2010).
\[
\rho(X, Y) = \frac{\sum \left( x_i - \bar{x} \right) \left( y_i - \bar{y} \right)}{\left[ \sum \left( x_i - \bar{x} \right)^2 \sum \left( y_i - \bar{y} \right)^2 \right]^{1/2}}
\]

**Equation 8.3: Linear comparison of responses between two questions using a Pearson correlation coefficient (Webb and Copsey, 2011)**

Based on the responses from Questions 28 and 29, it can be stated that there is evidence that social-cultural bias is not a factor in the current risk assessment process and that they do not really think of it as an important issue. One could expect that if the current health and safety risk assessment techniques and processes in the oil and gas industries of the MENA region do not take into consideration the psychology of risk in their scoring mechanism there could have been a very strong positive correlation between the response in questions 28 and 29; however, Table 8.5 shows a value of 0.42787, a positive but weak correlation.

Therefore, the hypothesis that “undertaking risk assessment in oil refineries where a diverse workforce uses a second language reduces the instances of incorporating the psychology of risk” was not strongly proven because there was a weak positive correlation between questions 28 and 29.
Table 8-5: Correlation coefficient result for comparison between questions 28 and 29

28. Using a likert scale of 1 to 5 where 1 stands for “Highly unlikely”, 2 stands “Unlikely”, 3 stands for “Not Sure”, 4 stands for “Likely” and 5 stands for “Most likely”, what is the likelihood that you would be influenced by your social-cultural “gut feeling” when making technical decisions?

<table>
<thead>
<tr>
<th>Highly</th>
<th>Unlikely</th>
<th>Not sure</th>
<th>Likely</th>
<th>Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>9</td>
<td>25</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>11%</td>
<td>14%</td>
<td>40%</td>
<td>29%</td>
<td>6%</td>
</tr>
</tbody>
</table>

29. When faced with a decision related to risk would you decide based on technical information even though it would go against your personal beliefs?

<table>
<thead>
<tr>
<th>Highly</th>
<th>Unlikely</th>
<th>Not sure</th>
<th>Likely</th>
<th>Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>5</td>
<td>24</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>14%</td>
<td>8%</td>
<td>38%</td>
<td>13%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Pearson Correlation Coefficient Value 0.42787
Another pair of questions that was asked to support the testing of the psychology of risk was 40 and 41 (in table 8.6). Question 40: “risk assessment processes could be introduced at social gatherings in an informal way” and question 44 stated “if people are at the centre of risk assessment, there is a high likelihood that the oil and gas installations in Kuwait could be very safe”. The result of the correlation coefficient between questions 40 and 44, shown in Table 8-6 shows a strong positive correlation of 0.924. This implies that even though the psychology of risk may not be central to the risk assessment process, respondents felt that people were central to the process of ensuring that oil and gas installations were safe.

Therefore the hypothesis that “undertaking risk assessment in oil refineries where a diverse workforce uses a second language reduces the instances of incorporating the psychology of risk” was not true.
Table 8-6: Correlation coefficient result for comparison between questions 40 and 44

<table>
<thead>
<tr>
<th>Totally Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Totally Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>13</td>
<td>32</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>13%</td>
<td>21%</td>
<td>51%</td>
<td>16%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Totally Disagree</th>
<th>Disagree</th>
<th>Neither Agree nor Disagree</th>
<th>Agree</th>
<th>Totally Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7</td>
<td>16</td>
<td>27</td>
<td>13</td>
</tr>
<tr>
<td>11%</td>
<td>25%</td>
<td>43%</td>
<td>21%</td>
<td></td>
</tr>
</tbody>
</table>

Pearson Correlation Coefficient Value 0.924
Validation Question 3: stated that “The current health and safety risk assessment techniques and processes in the oil and gas industries of the MENA region do not take into consideration the psychology of risk in their scoring mechanism. Would you agree with this statement?”

They were given three options: (i) Yes; (ii) No and (iii) Not sure

The response in Figure 8-3 shows that many participants in the validation exercise did not think that the current processes have an element of psychology of risk in them. There was a total of 68% that selected “no”. Therefore, we could argue that the elements of social cultural factors were not inherent in the risk assessment systems; but this did not imply that people were not central to risk assessments.

![Figure 8-5: Validation question 3: The current health and safety risk assessment techniques and processes in the oil and gas industries of the MENA region do not take into consideration the psychology of risk in their scoring mechanism. Would you agree with this statement?](image)
8.1.4 Testing of Hypothesis Four
The fourth hypothesis stated that “the future safety practice in oil and gas refineries can be robust if there is unification of diverse opinions about risk assessment” (section 1.5). The hypothesis was addressed through many questions in the later part of the questionnaire, especially questions 44 and 45.

a. Dependent variable (DV): robustness of the future safety practice was depended on the unification of the diverse opinions about risk assessment (IV)

b. Independent variable (IV): unification of diverse opinions about risk assessment could be implemented on its own based on management efforts; however, its implementation has a possibility to weaken or strengthen the safety practice at refinery level.

c. Group: oil refinery workforce of Kuwait

For instance, question 44 stated that “if people’s opinions are at the centre of risk assessment there is a high likelihood that the oil and gas installations in Kuwait could be very safe”, while question 45 stated that “the work environment could be allowed to integrate varied social-cultural and religious diversity”. It was important to test the response to the two questions using the Pearson correlation coefficient as a way of objectively assessing the opinion of the respondents. A Pearson correlation coefficient was performed on questions 44 and 45 which produced a positive 0.7373 which meant that there was a positive correlation between the work environment consideration as well as the use of people as central to risk assessment.

The hypothesis that “the future safety practice in oil and gas refineries can be robust if there is unification of diverse opinions about risk assessment” was found to be true and was fully supported by a very strong correlation coefficient value of 0.7373

One may argue that, from the two questions, respondents agreed to the proposition that a safer working environment depended on people and that it could reduce incidents, as shown in section 6.6, where many factors such as human factors, religious factors, culture and social connectivity have been assessed in terms of safety in the work environment. The results from the questions show that there is a belief that the psychology of risk could have a positive impact on safety.
This result from the Pearson correlation coefficient only provides an explanation that there is a perception that central to the reduction of accidents is the issue of allowing the integration of the social-cultural and religious factors. The strength to which this belief is held by the respondents was not explored further in this research because the issue of integrating such factors was not widely accepted during the research.

For instance, there were discussions in the interview process where some respondents felt it was not possible to deal with the psychology of risk in terms of the unpredictability of human behaviour as well as the influence of such behaviour in risk assessment. Others felt that, if one considers the demands of human factors, it could be argued that mechanism for assessing the risk assessor may be a possibility or that the monitoring mechanism could be instituted so as to ensure that the human factor and other social, cultural and religious attributes of an individual can be considered.
Table 8-7: Correlation coefficient result for comparison between questions 44 and 45

<table>
<thead>
<tr>
<th></th>
<th>Question 44: If people’s opinions are at the centre of risk assessment there is a high likelihood that the oil and gas installations in Kuwait could be very safe</th>
<th>Question 45: The work environment could be allowed to integrate varied social-cultural and religious diversity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation Coefficient Value</td>
<td>0.7373</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Totally Disagree</td>
<td>Disagree</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>11%</td>
<td>25%</td>
</tr>
</tbody>
</table>
Because hypothesis 4 was only tested using the Pearson correlation coefficient on questions 44 and 45, it was vital to validate the question at the interview phase. Validation Question 4: “addressing the psychology of risk in the oil refinery work environment could significantly reduce the number of incidents taking place in the refineries. Would you agree with this statement?” Respondents were given three options: (i) Yes; (ii) No and (iii) Not sure. The response in Figure 8-5 shows a support for the psychology of risk in the reduction of incidents but only by 61%. There were another 27% that did not think that was the case and another 14% that were undecided.

![Validation Question 4: Addressing the psychology of risk in the oil refinery work environment could significantly reduce the number of incidents taking place in the refineries. Would you agree with this statement?](image)

**Figure 8-6:** Validation question 4: Addressing the psychology of risk in the oil refinery work environment could significantly reduce the number of incidents taking place in the refineries. Would you agree with this statement?

Even though there is no literature which physically links the findings of hypothesis four to improvements in occupational health, it has been observed that bounded rationality is real (Buchanan and Huczynski 2010) and that human beings are not as rational as they are presumed to be (Yao and Li, 2013). Therefore, health and safety risk analyses are bound,
knowingly or unknowingly, to incorporate decision makers’ own social-cultural values and the behavioural codes of their generation (Koumakhov 2009, p294). Therefore, one could argue that allowing these elements in the health and safety risk analysis process would be bound to have a positive impact on the improvement of the safety and welfare of the workers in the oil and gas industry.

8.2 Summary
The results of the data primary collection and validation exercise have shown that the amalgamation of social-cultural dimensions within the risk assessment processes of the Kuwait Petroleum Corporation hydrocarbon facilities may have a critical role in promoting a risk culture in the operations. The result shows that, currently, technical risk assessment processes have been developed based on international standards applicable to general industries but they are used as rigidly as ever without due consideration to social, cultural and or human factors that can affect the assessors. Currently, the workforce is concerned with the technical integrity of the installations, hence there is little evidence that shows that workers link social-cultural factors to the overall risk assessment process.

The result from the chi-square test of association has indicated that the applications of lean principles in the hydrocarbon risk assessment exercises tend to vary in nature and that there is no consistency in the way they are being applied. However, there are similarities in the way respondents perceived bias towards the risk assessment process regardless of the various approaches taken to perform the risk assessment at work. This may lead to the belief that individual behaviour has been paramount in the way risk assessment exercises are performed. In addition, it could be argued that there may be a significant level of cognitive and social bias, as can be inferred from the results of the test. Therefore, the interaction of risk assessors, lean managers and the general workforce could be extremely important in the successful implementation of a lean hydrocarbon process without negatively impacting on the reliability and safety of installations. It may also be concluded that, unlike technical risk assessment, there could be inadequacies in the incorporation of social-cultural and psychological initiatives that may lead to poor decisions that have a possibility of endangering hydrocarbon installations. It is recommended that the hydrocarbon industry learns from the way the construction industry applies the concept of lean management when it handles complex projects with a view to promoting efficiency, value for money and a safer working
environment. Therefore, it is crucially important that the framework for assessing risks in the oil and gas terminals introduces social-cultural elements as an essential part of the process.

8.3 A Framework for a Social-Cultural Integrated Risk Assessment Model
Figure 8-7 shows a framework for introduction of social-cultural factors in the formal health and safety risk assessment in the oil and gas industry.

(i) Firstly, the model works as the basis for introducing an objective scoring measure that could be used to assess the health and safety risk perception within the work environment. Before the risk assessor commences the technical risk assessment, they would require to be evaluated in terms of their own view about the social, cultural, religious, work environment, experience and the use of available risk assessment standards. A scale of 1 to 10 is used so that the scores can be recorded as “worst case” if they are closer to 0 or best case if they are closer to 10. Using such scores it could be possible to create a maturity model for the safety performance of the systems that are deployed for risk assessment in oil refineries.

(ii) Secondly, if the score shows that the risk assessor is oblivious to social, cultural and related factors, they could be stopped from performing risk assessment and be redirected to the knowledge base for psychology of risk and decision making. However, if their score shows that they are aware of these factors they can proceed to performing the usual risk assessment, based on generic cycles such as that suggested in the model (Figure 8-7).
Figure 8-7: A Framework for introduction of social-cultural factors in the formal health and safety risk assessment in the oil and gas industry
### Table 8-8: Sample health and safety assessment template with sensitive social, cultural and religious questions relating to individual assessors

<table>
<thead>
<tr>
<th>Category</th>
<th>Set of questions</th>
<th>Worst Case</th>
<th>Moderate</th>
<th>Best Case</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Social Values</td>
<td>In your social circles, is fear of injury or death considered cowardice?</td>
<td>Totally Agree</td>
<td>Agree</td>
<td>Not sure</td>
</tr>
<tr>
<td></td>
<td>Do you believe injury or death is destined to happen and there is nothing you can do about it?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do your social beliefs affect your judgement on threats to your safety in work?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural Values</td>
<td>Does your culture promote fear?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Does your culture promote mutual respect?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Are you afraid to make safety decisions?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religious Inclination</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you believe in a religion?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you believe religion can intervene to protect you?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Do you believe religion keeps you safe in the work place?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work culture</td>
<td>Do you take safety seriously?</td>
<td>Totally Disagree</td>
<td>Disagree</td>
<td>Not Sure</td>
</tr>
</tbody>
</table>
Do you trust the systems around your work place? Is it not your responsibility to keep the environment safe?

**Work Experience**

- Do you think experience is important in your assessment of safety?
- Can you tell an unsafe situation just by looking or gut feeling?
- Do you have a positive attitude towards safety?

**Available standards**

- Do you have safety standards in the work place?
- Do you strictly adhere to available standards of safety?
- Do you think safety standards can keep you safe?
The third element of the integrated risk assessment model requires that the risk assessor understand the interpretation of values in Table 8-6, based on the explanation in Table 8.7 below, as well as Figure 8.7 below. In Table 8.7 the social and cultural factor awareness band (or scale) has been set to the following values:

a. Worst case for scales 1 and 2;
b. Poor case for scales 3 and 4;
c. Moderate case for scales 5 and 6;
d. Acceptable case for scales 7 and 8;
e. Best case scenario for scales 9 and 10

In the worst case scenario, there are two main issues (See Figure 8-7); it could be that there is no knowledge of the processes because individuals have just joined the refinery or that they are conditioned to follow systems blindly. Therefore, the solution is to offer training and to vary the approach to risk assessment.

In the poor case scenario, the main issues could be a lack of training and poor working pattern and a lack of information about the technical or social and cultural factors in health and safety assessment. Therefore, Table 8.7 states that they need to be offered training.

In the moderate case scenario, the main issue could be training, or work practice that does not recognise the social, cultural and religious views of the assessors. There is also an element of “beliefs”; hence there is a need to test individuals in this regard as to what their views are.

The acceptable case scenario is when the workforce is aware of both technical as well as social-cultural values in health and safety risk assessments to the extent that they can be integrated through demonstrations and management of the workforce. This indicates that the workforce would have demonstrated appropriate knowledge and understanding.

The best case scenario is where leadership within the teams can prevail, meaning that the workers can demonstrate knowledge and understanding, innovation and practice in the work environment.
These five steps are cardinal to the maturity of the integrated health and safety risk assessment that incorporates not only the technical but also the social and cultural values of the workers.

(iv) It is important to clarify the scales used in Tables 8-6 and 8-7. Starting with table 8-6, it can be observed that there are six categories of factors to test in the health and safety assessment, namely social values, cultural values, religious inclination, work culture, work experience and available standards. Each category has 3 questions, meaning that if each question is answered to the minimum score, we could obtain a total score of 18 (Table 8-7). This is illustrated in Table 8-7 where the possible scores are indicated assuming that all questions are answered.
Table 8-9: Explanation of the scale and actions to be taken for the health and safety assessment maturity model

<table>
<thead>
<tr>
<th>Social and Cultural Awareness Band</th>
<th>Social and Cultural Awareness Scale</th>
<th>Probability Scale</th>
<th>Social and Cultural Scores (Assuming all questions are answered)</th>
<th>Risk Classification of the Score</th>
<th>Action to be taken to move to the next Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worst Case</td>
<td>1</td>
<td>1</td>
<td>18-25</td>
<td>Very High</td>
<td>Orientation and Support to the working environment, the people and the systems. This is a presumed entry stage for employees, or the stage where employees become too familiar with the systems so that they become conditioned to the process and become careless.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>36-53</td>
<td></td>
<td>Orientation and training are specifically for health and safety risk assessment. At this stage, one expects to have been trained and be able to work with supervised duties related to oil and gas with safety awareness in mind. But they cannot be entrusted to perform safety assessments alone.</td>
</tr>
<tr>
<td>Poor Case</td>
<td>3</td>
<td>3</td>
<td>54-71</td>
<td>High</td>
<td>This is the stage where training and introduction of social, cultural and religious scenarios and beliefs can be introduced. The workers could have had technical training about health and safety; but they now need</td>
</tr>
<tr>
<td>Case</td>
<td>Medium</td>
<td>Low</td>
<td>Highly Desirable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>-----</td>
<td>------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>6</td>
<td>6</td>
<td>108-125</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acceptable</td>
<td>7</td>
<td>7</td>
<td>126-143</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Best Case</td>
<td>9</td>
<td>9</td>
<td>162-179</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
<td>180</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To be introduced to human factors and decision making processes and the fact that the health and safety assessments are not mechanical in nature and that all the people need to be considered.

At this phase, workers need to demonstrate that they can record their own experiences, management of scenarios, mentoring and test of competence. This is to ensure that they do not only help to transform their practice but also create a positive influence on the work environment.

This is the stage where the health and safety risks are manageable because the workers have recorded leadership tendencies, innovative suggestions and experience. The risks at this stage are beyond routine operations. All practices are globally acceptable as above board and necessary.
Figure 8-8: Five major steps in the health and safety assessment maturity model for the oil and gas refineries in Kuwait

- **Basic level competence in health and safety assessment processes** (Scale 3 and 4)
- **Upgraded basic level competence in health and safety assessment processes** (Scale 5 and 6)
- **High level competence in health and safety risk assessment at technical level with decision making** (Scale 7 and 8)
- **High level technical competences in risk assessment with social and cultural values as crucial factors in decision making** (9-10)
- **Inconsistent health and safety assessment processes** (Scale 1 and 2)
9. CHAPTER NINE: CONCLUSIONS AND RECOMMENDATIONS

9.1 General Conclusions

Based on the information from the review of literature as well as the primary data obtained through the questionnaire survey, interviews, case studies and the validation exercise, the following conclusions have been made:

i. Health and safety risks are a reality in the oil and gas industry and the workers are well aware of the importance of working in a safe environment. This means that the support for safety is extremely good at all stations that were surveyed.

ii. The number of incidents that have taken place around the world are not ignored by the research participants.
   a. However, the lessons learnt are only those related to the technical decision making.
   b. All the surveyed refineries have good health and preventative practices.

iii. There is a high level of concentration on technical risk assessment throughout the industry. The practice is extremely good such that the workers go through the processes mechanically, as they are designed, meaning that any deviation from the procedure is seen as unsafe behaviour.
   a. In other words there is a lack of appreciation for flexibility in the risk assessment process.

iv. The application of lean concepts in the oil refining process in Kuwait has not been purely linked to health and safety risks. However, respondents felt that lean management was indirectly implemented through cost saving measures.

v. Respondents acknowledged that the social-cultural tendencies of the workforce play a crucial role in the implementation of health and safety. If the workers are conditioned to take a relaxed approach, their response to threats could be abysmal, but if the workers are conditioned to respond in a specific manner, then any deviation from the norm would entail unpredictable responses to the incident.
vi. There is no health and safety risk assessment tool that performs formal recognition of bias in decision making due to the psychology of risk. All the systems do is to introduce preliminary meetings to set the scene and develop it from there.

vii. In contrast, if their psychological conditioning is to take a strong stance against threats, the work environment would be safe.

viii. The research recommends a framework for incorporating social-cultural values in the decision making process pertaining to health and safety risk assessment in oil refining process plants.

ix. The adoption of lean processes is rarely linked to the trigger for health and safety risks in the oil and gas industry. This research has firmly established that lean principles are finely balanced with cost cutting, with catastrophic consequences in the case where a wrong decision is made.

x. The workforce in the Kuwait oil and gas industry has a perception of health and safety risks which has been psychologically conditioned to “technical risks”; they ignore the social and cultural values or beliefs and their influence on risk score mechanisms.

xi. Therefore, the response to health and safety risks is largely dependent on cognitive and perceptual bias.

xii. The response to health and safety risks is not always measured, weighed and critically assessed, because human factors and social cultural values have a significant impact on the perception of health and safety risks in Kuwait.

xiii. Risk assessors are highly influenced by their social and cultural bias; therefore, the maturity model for safety needs to incorporate this element.

### 9.2 Contribution to Knowledge

i. There is no clear cut approach to allow for social, cultural and or religious factors in the process of risk assessment. For instance, if a driver is drunk with alcohol there is a breath test that can be performed but there is no way to test the ideas of thoughts of an individual when they have human related issues such as harbouring terrorist threats and lack of respect for life. This research has demonstrated that these elements could be sensitive, but they need to be recorded. It is a sensitive issue, but the recording of profiles or scores could be essential in assessing the risk for assessor. This principle is
well established in the aviation industry where human factor assessments are taken seriously.

a. The research has provided a template as an example with simple questions and scores to show respect for life, risk taking, and the like

ii. The way people perceive health and safety risks largely depends on their conditioning or training that they have been exposed to; however, no health and safety assessment technique recognises this factor

iii. Human factors and social cultural values in the oil refineries have not been directly linked and or applied to the possible impact that they could have on the process of health and safety risk assessment (section 8.1.1). This research may contribute to the knowledge of establishing a formal process for doing so

iv. Currently, the process of risk assessment ignores beliefs, values, cultural background, religious and social life (section 8.1.3 and 8.1.4). There could be a high likelihood of contributing to the knowledge base if the safety maturity model developed herein could form part of the risk assessment process. Because the maturity model takes a holistic view of the risk assessment model, it may have potential to positively influence health and safety risk assessment in oil refineries in Kuwait

9.3 Recommendations

The following recommendations have been considered as essential if we are to address occupational health and safety in the work place within the oil and gas industry:

i. There is a need to constantly renew the standard risk assessment procedures that are being used for monotonous as well as non-repetitive work procedures. The industry has standardised approaches to risk assessment that are only questioned when there is an incident. Therefore, to ensure dynamism in the risk assessment process, a key feature should be to keep changing the processes so that they can be more adaptable and robust

ii. The technical risk assessment processes need to be scaled down to operational level so that they are not intertwined with the management structure. Because of the culture of respect, some decision making has to take place and be authorised by senior managers. Clear authorisation processes are needed so that junior officers can act in the absence of senior managers.
iii. The oil and gas refineries need to appreciate the social, cultural and religious environment they are operating in, not only as a threat to the technical operations but as a means to complement efforts that are aimed at promoting high standards for occupational health and safety. This would be possible if the work environment can recognise social and cultural differences, just like they recognise experience in the workforce. If social, cultural and religious values are considered as important to the safety of the work environment, it could improve transparency in the decision making process at times of risk assessment. For example, work environments in Kuwait recognise the importance of people’s culture and their respect for religion. Employers provide prayer rooms and this is a good sign that it is possible to introduce social factors in formal risk assessment processes

a. In other words there is a need to introduce the assessment of the risk assessor so that their profile is well understood in relation to the way they consider occupational health and safety

iv. Lean production needs to be integrated with the rational and cognitive detection attributes of health and safety risk assessment. While lean practices are essential to the reduction of unnecessary waste within the production process, there is no evidence showing that managers explain the realities and its effect on health and safety. This research, therefore, recommends a more integrated approach to the introduction of lean management while linking it to potential threats to the safety of workers and the installations

v. The Pavlov conditioning theory needs to be well explained in team meetings in order to avoid the problems of those that are overly experienced feeling that they can make decisions based on gut feeling and not technical, social, cultural and or religious factors. The only way to deal with complacency which is driven by experience would be to constantly keep refresher training programs that highlight the dangers of repetitive work in a work environment where the workforce is complacent with safety measures

9.4 Proposed Further Research

i. The sensitivity of the culture and religious issues in creating scores for risk assessors in the MENA region.
This research is proposed as a response to the implications of the recommendations made herein. Developing risk assessment templates that are culturally sensitive could require further research about people and the dynamism of work culture, especially within the MENA region. At the moment the MENA region is predominantly Islamic in culture and has a large expatriate workforce which has been incorporated by their companies or by their expertise to support the oil and gas industry. Take, for instance, Chevron whose main technical teams originate from the United States of America (USA), and other specialists have been brought into the organisation either from the Western world or from South America. The company has also got a team of workers (skilled and unskilled) which originates from the Middle East and the North African (MENA) region.

We could, therefore, argue that there are many cultures within a single company let alone the whole oil and gas industry. The perception of Western engineers about the sensitivity of culture and religious beliefs varies depending on the perception of people who originate from the MENA region. The status quo allows all forms of workers to follow the stipulated procedures that could have been designed by the Western manager to be improved for the workforce with no international exposure.

There are tremendous tensions and culture clashes in the production lines such that differences in ideologies as well as the varying cultural dimension tend to compound the problem in an industry in which the work culture is already volatile or hard. As a result, companies ignore the culture clashes as a “management” issue and not a cultural issue. We could argue that, as much as management tries to bottle the reactions, differences and frustrations mean that productivity tends to suffer. It is, therefore, important that research be conducted about the sensitivity of cultural and religious factors and beliefs on the risk assessor within the MENA region. The focus should be on the risk assessor, as an entity who strives to negotiate social and cultural differences with those that they work for or with on the production line.

It is justified to propose further research within the area of risk assessment for the oil and gas industry within the MENA region because one can see that the cultural insensitivity amongst employers is a disaster waiting to happen in a situation in which the risk profiling of the workers is influenced by predetermined perceptions of the employers or investors. Many risk assessment procedures are devoid of sections that concentrate on the risk assessor and the way that assessor is impacted on by the cultural and religious beliefs of the people that are in
the work environment. There are many Western-based oil companies that have high standard procedures that count for nothing because the local assessor may need further training to be able to use them adequately. Harmonisation of the standards should, therefore, begin with a deeper understanding of one’s culture and beliefs.

ii. Pavlov conditioning and training for risk assessment in the oil and gas industry.

The training programmes for health and safety risk assessment are ongoing; however, there is little evidence of considerations made for experience and work conditions that oil and gas installations create. Anyone that is employed by a multi-national oil and gas organisation undergoes induction, training and health and safety briefings for all sections until they are given a full security and risk briefing for the area that they are to work in. The level of conditioning is extremely high to the point that procedures have to be memorised before tasks are implemented. There are standard templates for use in risk assessment whereby the users of the templates start being conditioned to using the headings and or the profiling of the risks in accordance with ones that are commonly identifiable. The conditioning creates streamlined response mechanisms for faster responses but also stifles originality especially for a risk assessor to think outside the box as they try to deal with risk assessment. This is a perfect example of Pavlov conditioning because workers anticipate standard procedures all the time.

In reality, standard approaches count for nothing when an incident materialises because the response team is used to following the existing procedures that have been approved over the years. This implies that while it takes a longer time to condition the behaviour of response to incidents, it could also take a long time for a worker to decipher the need to speed up reactions when there is an incident so as to protect people or the company equipment. It is, therefore, necessary to introduce such research which could help in the development of a structured way for deconditioning those that are conditioned to work in a specific way.

Debriefing and deconditioning the workers whose main work has been procedural could be complex because of the disruptive approach that debriefs and decommissioning programs introduce to people and the working environment. This research could facilitate the
development of a two way approach to training risk assessors where they are conditioned but they can equally be debriefed and can continue within the framework of the professional approach to handling risk.

This topic is also justified because conditioning which takes place in the work environment stifles originality and authenticity of decisions that are made by some employees. However, if all employers or a selected few are trained to deal dynamically with the changing work environment, they many not react to or prevent possible incidents. Therefore, more research work is needed on how to un-condition workers so that their decisions can reflect the dynamic nature of the work environment.

iii. Translation of a template for assessment to be achievable and easier to apply to the multi-national workforce at the same time.

It is important to undertake the translation of the risk assessment templates that have been proposed in section 8.3 of this research. This could make it easier for teams to apply the techniques in their own language and facilitate the pattern of knowledge dissemination.
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APPENDIX A: SAMPLE OF THE QUESTIONNAIRE USED IN THE SURVEY

University of Manchester
Manchester, UK

Introduction
This questionnaire has been designed to gather primary information from Kuwaiti oil refineries and related facilities. The information is meant to be used in the research entitled: “SIX ELEMENT MATURITY MODEL FOR HEALTH AND SAFETY IMPROVED PERFORMANCE IN KUWAITI OIL SECTOR”. All the information given herein is meant to be used for academic purposes only. The research work is part of the requirements for the degree of Doctor of Philosophy at the University of Manchester, UK.

SECTION ONE: GENERAL INFORMATION ABOUT RESPONDENTS

1. State your company position
☐ Engineer, ☐ Manager, ☐ Risk Manager, ☐ Senior Manager, ☐ Mechanic, ☐ Safety Manager, ☐ Financial Manager, ☐ Others (Please State: Click here to enter text.)

2. Select the number of years worked for the company
☐ Insignificant experience; ☐ 1–5 years; ☐ 6–10 years;
☐ 11–15 years; ☐ More than 15 years

3. Select the industrial experience in the Kuwait oil and gas
☐ Insignificant experience; ☐ 1–5 years; ☐ 6–10 years;
☐ 11–15 years; ☐ More than 15 years

4. Any other experience apart from Kuwait (State the Country: Click here to enter text.)
☐ Insignificant experience; ☐ 1–5 years; ☐ 6–10 years;
☐ 11–15 years; ☐ More than 15 years

5. Category of Age that you fall under:
☐ 30 years and below; ☐ 41–50 years; ☐ 51 years and above

6. Select Educational qualifications:
   ☐ Diploma; ☐ Bachelor's degree; ☐ Master's Degree; ☐ Doctorate

7. Select your country or region of origin
   ☐ Kuwait; ☐ Middle East and North Africa; ☐ Europe; ☐ USA or Canada; ☐ other
   (please indicate where): Click here to enter text.

SECTION TWO: LEAN PRACTICES IN THE REFINERY OPERATIONS

8. Do you think the oil refinery plant you work from has been designed to be operated safely?
   ☐ No; ☐ Yes; ☐ Don't know; ☐ No comment

9. Does your department get involved in the segmentation and segregation of the production processes?
   ☐ No; ☐ Yes; ☐ Don't know; ☐ No comment

10. Using a likert scale of 1 to 5 where 1 stands for “Highly Inefficient”; 2 stands for “Inefficient”; 3 stands for “Not sure”; 4 stands for “Efficient”; and 5 stands for “Highly Efficient”; rate the level of efficiency of the segmentation of the oil refinery your work from.
    ☐ Highly Inefficient; ☐ Inefficient; ☐ Not Sure; ☐ Efficient; ☐ Highly Efficient

11. Is the flow of oil and gas products well arranged in the factory or not?
    ☐ No; ☐ Yes; ☐ Don't know; ☐ No comment

12. What is the general cleanliness and orderliness of the installations before they are used in the refining process?
    ☐ Highly Untidy and poor orderliness; ☐ Untidy and poor orderliness; ☐ Not Sure;
    ☐ Tidy and good orderliness; ☐ Very tidy and high orderliness

13. Is there a standard way of reducing operational waste?
    ☐ No; ☐ Yes; ☐ Don't know; ☐ No comment
14. Using a likert scale of 1 to 5 where 1 stands for “Highly Inefficient”; 2 stands for “Inefficient”; 3 stands for “Not sure”; 4 stands for “Efficient”; and 5 stands for “Highly Efficient”; rate the level of efficiency of the waste management system present in your factory?
☐ Highly Inefficient; ☐ Inefficient; ☐ Not Sure; ☐ Efficient; ☐ Highly Efficient

15. Do you think the procedure for reducing waste in the production process has a positive impact on risk behaviour for the workforce?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

16. Do you observe self-discipline and commitment from the workforce when they are implementing waste management processes?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

17. Are there training programs for the workforce?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

**SECTION THREE: INTEGRATED RISK MANAGEMENT PROCESSES IN REFINERIES**

18. Does your job involve making decisions that affect the safety of other people or the protection of key installations?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

If your answer is “Yes”: Please explain how: [Click here to enter text.]

19. Does your job involve responding to the decisions that are necessary for the safety and integrity of the factory?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

20. Are you involved in the planning for the risk assessment processes?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment
21. Are you aware of the risk assessment tools for the oil and gas industry in general?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

If your answer is “Yes”: Please explain: Click here to enter text.

22. Using a likert scale of 1 to 5, where 1 stands for “very low”; 2 stands for “low”, 3 stands for “moderate”; 4 stands for “high”, and 5 stands for “very high”; rate the application of the lean principles when they are performing their risk assessment at work under the following headings:
(a) Waste and Efficiency (W&E): ☐Very Low; ☐Low; ☐Moderate; ☐High; ☐Very High
(b) Planning and Control (P&C): ☐Very Low; ☐Low; ☐Moderate; ☐High; ☐Very High
(c) Customers focus (C-F): ☐Very Low; ☐Low; ☐Moderate; ☐High; ☐Very High
(d) Continuous Improvement (C-I) ☐Very Low; ☐Low; ☐Moderate; ☐High; ☐Very High
(e) Cooperative Relationships (C-R) ☐Very Low; ☐Low; ☐Moderate; ☐High; ☐Very High
(f) Systems thinking: ☐Very Low; ☐Low; ☐Moderate; ☐High; ☐Very High

SECTION FOUR: SOCIAL-CULTURAL VALUES AT THE WORK PLACE

23. Do you have family ties in the work place?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

24. Do you have friends working in the same place?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

25. Have you got people you trust to work with?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

26. Does your work culture allow formal recognition or respect for the official position of people in their decision making?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

27. Do you consider age as a key indicator of authority by decision makers?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

28. Using a likert scale of 1 to 5 where 1 stands for “Highly unlikely” ; 2 stands “Unlikely”; 3 stands for “Not Sure”; 4 stands for “Likely”; and 5 stands for “Most
likely”; what is the likelihood that you would be influenced by your social-cultural “gut feeling” when making technical decisions?
☐ Highly Unlikely; ☐ Unlikely; ☐ Not sure; ☐ Likely; ☐ Most Likely

Please explain the reason behind your choice: Click here to enter text.

29. When faced with a decision related to risk; would you decide based on technical information even though it would go against your personal beliefs?
☐ Highly Unlikely; ☐ Unlikely; ☐ Not sure; ☐ Likely; ☐ Most Likely

Please explain the reason behind your choice: Click here to enter text.

SECTION FIVE: TESTING THE BIAS ON TECHNICAL RISK ASSESSMENT

Human factors

30. How strictly do you follow the work procedures, manuals, and checklists at work?
☐ Not at all strictly; ☐ a bit strictly; ☐ Don't know; ☐ Strictly; ☐ Very strictly

31. Do you allow experience to overrule procedure, manuals and or checklists?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

32. How strictly do you abide by the standard procedures for using tools and instruments?
☐ Not at all strictly; ☐ a bit strictly; ☐ Don’t know; ☐ Strictly; ☐ Very strictly

33. Does the physical work environment support or hinder the smooth operation of risk assessment?
☐ No; ☐ Yes; ☐ Don't know; ☐ No comment

34. Does management decision structure overrule technical decision makers?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

Religious factors
35. Are work patterns in line with your religious beliefs?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

36. Are you allowed to practice your religion even at work?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

37. Do you consider your safety and the safety of others to be necessary in your religion?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

38. Do you think prayer should supplement the adherence to technical procedures?
☐ No; ☐ Yes; ☐ Don’t know; ☐ No comment

39. Using a likert scale of 1 to 5, where 1 stands for “very low”; 2 stands for “low”, 3 stands for “moderate”; 4 stands for “high”, and 5 stands for “very high”; rate the level of social and cognitive bias in the risk assessment process.
☐ Very Low; ☐ Low; ☐ Moderate; ☐ High; ☐ Very High

SECTION SIX: ADOPTING A STRATEGY TO PROMOTE INTEGRATED RISK ASSESSMENT THAT RECOGNISES SOCIAL-CULTURAL VALUES OF THE WORKFORCE

40. Risk assessment processes could be introduced at social gatherings in an informal way
☐ Totally disagree; ☐ Disagree; ☐ Neither agree nor Disagree; ☐ Agree; ☐ Totally Agree

41. Work culture could be used as way of assessing compliance with risk assessment procedures at work
☐ Totally disagree; ☐ Disagree; ☐ Neither agree nor Disagree; ☐ Agree; ☐ Totally Agree

42. It would be possible to strengthen risk assessment protocols using religious beliefs that teach the sanctity of life
☐ Totally disagree; ☐ Disagree; ☐ Neither agree nor Disagree; ☐ Agree; ☐ Totally Agree
43. Management structure could be designed to allow for technical competence as well as social positioning of the workers to be recognised in decision making
☐ Totally disagree; ☐ Disagree; ☐ Neither agree nor Disagree; ☐ Agree; ☐ Totally Agree

44. The work environment could be allowed to integrate varied social-cultural and religious diversity
☐ Totally disagree; ☐ Disagree; ☐ Neither agree nor Disagree; ☐ Agree; ☐ Totally Agree

45. If people are at the centre of risk assessment there is a high likelihood that the oil and gas installations in Kuwait could be very safe
☐ Totally disagree; ☐ Disagree; ☐ Neither agree nor Disagree; ☐ Agree; ☐ Totally Agree
APPENDIX B: SAMPLE OF THE ETHICAL APPROVAL FOR THE RESEARCH

THE UNIVERSITY OF MANCHESTER
COMMITTEE ON THE ETHICS OF RESEARCH ON HUMAN BEINGS

Application Form for Approval of a Research Project for Students on a PhD or MPhil programme in the School of Mechanical, Aerospace & Civil Engineering

This form should be completed by the Student and the Main Supervisor, after reading the SED guidance notes. It should then be submitted to the School via the named contact on the School intranet, to be screened at School level prior to submission to the University Research Ethics Committee.

1. Title of the research

SIX ELEMENT MATURITY MODEL FOR HEALTH AND SAFETY IMPROVED PERFORMANCE IN KUWAITI OIL SECTOR

2. Chief Investigator (in the case of PhD Applications, the Main Supervisor is a co-applicant)

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School Administrator (to be copied to any correspondence from UREC)
3. Details of Project

3.1 Proposed study dates and duration

Start date: 01.11.2010
End date: 01.04.2014

3.2 Is this a student project?

Yes
If so, what degree is it for? PhD in (Management of Management)

3.3. What is the principal research question/objective?

The aims of the research are twofold:

(i) To evaluate the impact of social-cultural values on the technical risk management strategies in oil refineries in Kuwait.
(ii) To critically examines how the application of the lean concept in the hydrocarbon industry of Kuwait could be inducing (or otherwise) biased judgment of risk assessors.

The following objectives have been developed:

(i) Assess overall technical approach to risk management in the purification processes;
(ii) Evaluate the social cultural environment for the oil refineries;
(iii) Examine the application of lean management in the risk assessment process and how its impacted by biased personal judgment;
(iv) Assess the impact of social cultural environment on the technical application of risk management;
(v) Recommend a framework for adopting social-cultural values in the risk assessment process at industrial level.

Research Hypotheses

The following research hypotheses have been developed as a vehicle for technical verification of research aims:

i. It could be argued that the current approach to risk management in Kuwait oil refineries over-relies on technical data;
   a. hence overshadowing the social cultural context within which the risk management takes place.
ii. There is a high likelihood that leaning the risk assessment process in the oil and gas industry could be induced by biased decision making due to social-cultural values of risk assessors.
iii. Addressing the social cultural environment could improve the perception of risk management, and positively impact the risk outlook (profile) for the refineries

3.4. What is the scientific justification for the research? What is the background? Why is this an area of importance / has any similar research been done?

Justification for the research

The economic driver for the construction and operation of the oil refinery tends to be more important because of the generally huge initial financial outlay, and the eventual high costs of maintenance; hence risk management should have evidence of ensuring that the installations as well as the people that work in them are well catered for. In Kuwait Petroleum Corporation (KPC), this problem is more evident in newer installations because of the strategic interest not only from the executives but also the government. There in lines the initial problem of integrating risk management because side lining factors such as social cultural elements of the workforce could lead to poor risk management implementation.

Even though some of the risks are more pronounced than others, the oil and gas risks could not be managed without placing it on the cultural, sociological and psychological context (Hokstad and Steiro, 2006). This means that the review of policy with social-cultural and psychological perspective is centred on preparation and understanding human error when the works are being executed (Aven, 2008). Human error emanates from the issue of human factors as far as risk and health and safety are concerned (Sjoberg, 2001). In a wider sense, the term “human factors” refers to the behaviour of humans that can affect workplace risk, and has the following characteristics (Targoutzidis, 2010):

• Intentional behaviour – which involves conscious risk-taking by means of deliberate acts not in accordance to the explicit safety rules;

• Unintentional behaviour – which involves erroneous acts that violate the explicit safety rules.

“Both these kinds of behaviour can affect safety in the workplace and thus have to be incorporated in the assessment of risks in order to take situation-specific conditions into account” (ibid).

Like any industry, safety of the workforce and the public is paramount. By industrial safety, we mean “the control of persons, materials, machines and systems of work in order to provide and maintain a working environment in which people will not be injured, or suffer damage to their health, or in which property is damaged” (HSE, 2005). This also means that the health and safety cannot be looked at as an isolated theme, rather as an integral part of the overall productions system of the industry and that integrating the management of health and safety risks would eventually benefit more elements of risk inherent in the industry. Hokstad and Steiro (2006) contended that the way to integrate the management of health and safety risks is to take a holistic approach. This would take “a unified and common
strategy for assessing and handling risk, based on a ‘common language’ concerning integration.

This research explores the identification and evaluation of the mechanisms that could facilitate the integration of the risk management strategies with full recognition the social-cultural values and the impact such values could have on the technical risk management in oil refinery business of Kuwait.

Background of the Research

The management of risks in the oil refinery tends to be centred on the collection and simulation of technical data which can then be used to make decisions on the wellbeing of the workforce as well as the refinery installations. While the number crunching in the process is immensely vital, there tends to be a problem of ignoring if not side-lining the social cultural values of the people dealing with risk management processes. In times requiring decision making, a number of concepts and models can be used. Ultimately, integrating the decision analysis processes become crucial for a proactive risk management strategy for any industry. For instance, decision analysis involves concepts borrowed from probability theory, statistics, psychology, finance, and operations research (Schuyler, 2001); which means that there are elements of social-cultural understanding within the risk management processes. However, the many elements of decision analysis, if disintegrated, would yield a poor result for risk management. The PMI (2004) define integration management as “the processes required to ensure that the various elements of the project are properly coordinated”. The main aspect of project integration management is that project planning development, project plan execution and integrated change control (ibid) are used as early as possible for all aspects of a project. If applied to the management of risk or the assessment of risk, ‘Integrated risk assessment” has been defined as “a process that combines risks from multiple sources, stressors, and routes of exposure for humans, biota and ecological resources in one assessment” (Assmuth and Hilden, 2008).

Why is this an area of importance / has any similar research been done?

Over the years, the hydrocarbon industry has been developing robust risk assessment techniques of various nature including probabilistic approaches (Wang et al, 2011) that can simulate most difficult working conditions such as those related to fire and the like (Aven, 2008). In reality risk assessment is influenced by human decisions as much as they are influenced by technical decisions. The implication of such a scenario has been that whenever there are operational costs cutting measures and or waste reduction in the production process, risk assessment is used to rubberstamp the process; hence endangering the safety of the workforce as was the case with Gulf of Mexico accident (Lean, 2010). However, when a disaster ensues, investigations would show that leaning the
production process may result in biased risk assessment processes that may negatively impact the installations as well as those working on such installations.

This research aims at exploring the use of integrated risk management in the hydrocarbon industry of Kuwait, by assessing how the social-cultural and behavioural tendencies of the local workforce would impact the risk performance of the industry for the future when there would be less reliance on expatriate workforce.

For a long time, Kuwait, like any other country in the Middle East and North African (MENA) region, has relied on the technical manpower from the international community especially in the management of oil and gas facilities regarding the risks, health and safety. However, there has been a constant pressure to replace international expatriates with local personnel. Technically, there is no technical problem with the approach, though there are management constraints in the maintenance of the levels of performance that have been seen by the international personnel mainly because the attitude towards work, risk, health and safety, has been reinforced over the years by the social-cultural and behavioural tendencies that each worker brings to Kuwait.

The inherent implication of the policy of replacing international personnel in the hydrocarbon industry of Kuwait is that the systems of managing the risks would have to, inevitably, take on the technical as well as a social cultural dimension. The social-cultural dimension need clear understanding and mapping into the system of things as they stand

Even though risk management as a body of knowledge has been explored to a great detail, there has been little evidence of strategies that may be used to profile risks from the perspective of the social-cultural view of the Kuwaitis working in the hydrocarbon industry.

It is therefore envisaged that this research would make a significant contribution to the incorporation of social-cultural values in the risk assessment process; and reduce the influence of human factors on incidences on hydrocarbon installations in Kuwait.

3.5. How has the scientific quality of the research been assessed?

(Tick as appropriate)

☐ Independent external review
☐ Review within a company
☐ Review within a multi-centre research group
☒ Internal review (e.g. involving colleagues, academic supervisor)
☐ None external to the investigator
☐ Other, e.g. methodological guidelines (give details below)

If relevant, describe the review process and outcome. If the review has been
3.6. Give a full summary of the purpose, design and methodology of the planned research, including a brief explanation of the theoretical framework that informs it. It should be clear exactly what will happen to the research participant, how many times and in what order. Describe any involvement of research participants, patient groups or communities in the design of the research.

The design and approach to research has been based on the interpretivist approach, as explained in Saunders et al (2009) where the emphasis should be to gather primary information using a qualitative system that is able to recognise the nature of social connectivity amongst respondents. This means that the data collection tools have to include:

(i) Literature search for all the secondary data on risk assessment, psychology of risk and human interactions in the process of assessing risks;
(ii) Questionnaire survey which would facilitate the collection of primary data from practitioners working on various Kuwaiti oil installations. The purpose of proposing a questionnaire survey has been to highlight all the key areas of the research so that the respondents could be afforded a chance to evaluate the questions further and be able to examine and respond to those questions that they may feel it would be necessary to respond to.
(iii) Interview survey to allow detailed discussions on the subject matter but guided by the questionnaire template so as to reduce on deviations from the subject matter. The purpose of using an interview is that because the social-cultural elements form part of human nature, it would be difficult to gain an insight into the decision making processes of risk assessors without having detailed discussions with them.

This means that the research methodology for this project has been designed to use a mixed methods approach for gathering both secondary and primary data.

The theoretical framework that informs the research methodology is founded on the basis that there exist many forms of risk assessment techniques and approaches in many industries. However, the perception of risk assessors varies from region to region; mainly due to the social and cultural differences. Therefore each time a good risk assessment model is to be used, the results could be different. This means that the risk profiling of the work process has a lot to do with human judgement; hence the possibility of biased judgement. This phenomena needs to be examined for the context of the oil and gas industry in Kuwait where the policy of replacing expatriate workforce with local workers needs to be implemented.
3.6.1. Has the protocol submitted with this application been the subject of review by a statistician independent of the research team?
(Select one of the following)

- Yes – copy of review enclosed
- Yes details of review available from the following individual or organisation
  (give contact details below)
- No – justify below

The level of statistical analysis required could be managed by the researcher; especially that the research population is regional; and that the sample size is envisaged to be small. Additionally, stratified sampling has been envisaged to be the best approach for sampling the population so as to target the workforce that is involved in risk assessments at the work place. Because the research methodology has been designed to follow an interpretivist approach, data analysis will largely be qualitative in nature; hence requiring minimal statistical analysis that would need the services of a statistician.

3.6.2. If relevant, specify the specific statistical experimental design, and why it was chosen?
N/A

3.6.3. How many participants will be recruited?

The research has a target of 50 respondents for semi-structured interviews, and any number greater than 100 participants for the questionnaire survey.

3.6.4. How was the number of participants decided upon?

The main guideline for arriving at the number of participants has been driven by the recommended sample sizes for ensuring that the research results could be valid (Saunders et al, 2009). The sampling frame is based on the identification of all the workers in the oil and gas industry within the Middle East and North African (MENA) region. Based on such a sampling frame, it would be possible to find participants of more than 100. Such a number is said to be valid for research within the engineering industry (Naoum 2007; Fellows and Liu (2008). Therefore the sampling frame has been set is likely to be any number more than 100.
3.6.5. Describe the methods of analysis (statistical or other appropriate methods, e.g. for qualitative research) by which the data will be evaluated to meet the study objectives.

Apart from qualitative data analysis, the most ideal data analysis would be the use of the chi-square test of independence; because it allows the analysis of qualitative response based on categorical data. Therefore the questionnaire has been designed in such a way that allows respondents to categorise their response to questions hence allowing the possibility of comparing the responses based on chi-square test. Using Minitab, it is possible to perform the analysis for categorical data; and then supplement the analysis from detailed discussions based on interviews.

The objective is to ensure that qualitative information that is obtainable from the sample can be analysed as objectively as possible using reliable descriptive statistical methods such as graphs and figures. All the analysis need to be in line with the research objectives and the aim of ensuring that the social-cultural variances are captured in the risk assessment process for the hydrocarbon industry.

3.7. Where will the research take place?

The research will be taking place in the following areas

(i) The University of Manchester, in the United Kingdom
(ii) In Kuwait

3.8. Names of other staff involved.

N/A

3.9. What do you consider to be the main ethical issues which may arise with the proposed study and what steps will be taken to address these?

The main ethical issues identified are:

(i) Respondents need consent to participate and give honest opinion on the risk assessment process without feeling pressured to participate
(ii) There is a high likelihood for respondents to feel that the work could be compromised or that they are being investigated for their performance
(iii) There is a possibility that they may feel profiled because of their religion, cultural background and social profiling as they are being asked to participate
(iv) There is a possibility that respondents may feel that the questions could be too personal and it might ruin their career

Steps to deal with ethical issues:

The following steps have been identified as essential in ensuring that ethical issues are addressed

(i) There is a need for assuring respondents that this is an academic exercise meant to improve risk assessments in the industry; and for the betterment of the hydrocarbon industry in the region

(ii) The questions have been designed to ensure that they avoid personal questions such as names, and work email addresses. The respondents would be asked to consent to participation and if they so wish they could withdraw their consent.

(iii) There is a design where data collected is anonymised so that there is no way of identifying the respondents and that all data will be located in a password protected spread sheet

(iv) It is also important to create pseudonyms for all respondents so that no other person can know where the data came from. No other individual or organisations will have access to the data. Any member of the supervisory team would only have access to analysed data. No real names will be used to represent individuals when separating the findings of the study.

(v) After data analysis and publication of the research findings, respondents will be given a chance to validate the information; and once approved the data will be deleted.

3.9.1. Will any intervention or procedure, which would normally be considered a part of routine care, be withheld from the research participants?

☐ Yes ☐ No

4. Details of Subjects.

The main details of the participants are professionals working in various organisations within the hydrocarbon industry around Kuwait and the MENA region

4.1. Total Number: More than 150 people

4.2 Sex and Age Range: all workers in their various managerial and operational capacities in the work place; with respect to labour laws of every country.
4.3 Type: Professionals and non professionals.

4.4. What are the principal inclusion criteria? That they work for a hydrocarbon factory, at refinery or at extraction stage; and that they may be involved in risk assessment and risk profiling within their line of work.

4.5. What are the principal exclusion criteria? Those people that may not issue consent to participate and those that do not work in the industry at the time of the research data collection

4.6. Will the participants be from any of the following groups? (Tick as appropriate)

☐ Children under 16  ☐ Adults with learning difficulties  ☐ Adults who are unconscious or very severely ill  ☐ Adults who have a terminal illness  ☐ Adults in emergency situations  ☐ Adults with mental illness (particularly if detained under mental health legislation)  ☐ Adults with dementia  ☐ Prisoners  ☐ Young offenders  ☐ Adults in Scotland who are unable to consent for themselves  ☐ Healthy volunteers (this is only relevant in the context of medical interventions so do not tick)  ☐ Those who could be considered to have a particularly dependent relationship with the investigator, e.g. those in care homes, medical students.  ☐ Other vulnerable groups

Justify their inclusion

N/A

4.7. Will any research participants be recruited who are involved in existing research or have recently been involved in any research prior to recruitment?

☐ Yes  ☐ No  ☐ Not known

If Yes, give details and justify their inclusion. If Not Known, what steps will you take to find out?

4.8 How will potential participants in the study be (i) identified, (ii) approached and (iii) recruited?

Identified
The main identification process of the participants in the research is their line of work and the industry they work with. The oil and gas industry has specialised installations and that they tend to be well secured. Hence going by the industrial stratification it is possible to identify the potential participants at industry level. These could be operational managers, engineers, and general operatives.

**Approached**

The ideal approach is to write a formal letter to the operations managers of the institution and explain to them about the research project. Then seek permission to send questionnaires so that the workforce that can consent to participation can participate.

**Recruited**

After getting permission from the institutions and from the individuals, it is now going to be possible to recruit the participants.

4.9 Will individual research participants receive reimbursement of expenses or any other incentives or benefits for taking part in this research?

○ Yes ■ No

*If yes, indicate how much and on what basis this has been decided*

5 Details of risks N/A

5.1 Drugs and other substances to be administered

*Indicate status, e.g. full product licence, CTC, CTX. Attach: evidence of status of any unlicensed product; and Martindales Pharmacopoeia details for licensed products*

<table>
<thead>
<tr>
<th>DRUG</th>
<th>STATUS</th>
<th>DOSAGE/FREQUENCY/ROUTE</th>
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<tr>
<td>N/A</td>
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5.2 Procedures to be undertaken

N/A

5.3 Activities to be undertaken

Because of the wide nature of the industry, it is important to consider delivering the questionnaire to respondents through the following means:

(i) Electronic mail where respondents can receive an electronic copy of the questionnaire for them to fill in as much information as they can. This also means that they can be free to fill in without having the pressure to be forced to do that by the presence of the researcher

(ii) Another way of delivering the questionnaire would be in person where the researcher hands the questionnaires to the departmental heads of the companies for them to ask the relevant persons to participate and fill in the questionnaire

(iii) The third method would involve the use of postal delivery method to the various companies

The justification for proposing these three methods are that there is a need to have many ways of delivering the questionnaire so as to increase the chances of participation.

The interviewees will be identified in a similar manner and the request for the interview schedule will be agreed. The questionnaire template will provide the main themes of the interview so that the response does not vary excessively from that of the questionnaire proper. Therefore it will be a semi-structured interview.

5.4 What are the potential adverse effects, risks or hazards for research participants, including potential for pain, discomfort, distress, inconvenience or changes to lifestyle for research participants?

There are no potential hazards or adverse effects for the research participants; except that they may feel intimidated or fearful of their positions if they are not asked to participate properly. Therefore, it is important to consider the culture of respect and
procedure when conducting the research with participants so that they feel part and parcel of the process

5.5 Will individual or group interviews/questionnaires discuss any topics or issues that might be sensitive, embarrassing or upsetting, or is it possible that criminal or other disclosures requiring action could take place during the study (e.g. during interviews/group discussions, or use of screening tests for drugs)?

☐ Yes  ■ No

If yes, give details of procedures in place to deal with these issues:

5.6 What is the expected total duration of participation in the study for each participant?

The estimated total duration is about 1 and 30 minutes

5.7 What is the potential benefit to research participants?

There are no anticipated benefits to the research participants

5.8 What is the potential for adverse effects, risks or hazards, pain, discomfort, distress, or inconvenience to the researchers themselves? (If any)

There are no anticipated risks to the researcher because the work environment is familiar.

6. Safeguards

6.1 What precautions have been taken to minimise or mitigate the risks identified above?
The precautions to undertake during data collection are as follows: (i) be procedural for seeking permission from the participants so that the culture of respect and procedure is followed strictly; (ii) politeness when asking the people for participation is crucial as it would ensure that the participants feel part of the process; (iii) the procedures needs to allow more flexibility and time because that is the nature of work processes. This means that there is a need for more patience.

6.2 Will informed consent be obtained from the research participants?

- Yes  ○ No

*If Yes, give details of who will take consent and how it will be done. Give details of the experience in taking consent and of any particular steps to provide information (in addition to a written information sheet) e.g. videos, interactive material.*

A consent form would be useful for the participation of the respondents. This means that they can allow or refuse participation. Herewith attached is a consent form designed for the participants.

6.3 Will a signed record of consent be obtained?

- Yes  ○ No

*If not, please explain why not.*

6.4 How long will the participant have to decide whether to take part in the research?

2 weeks

6.5 What arrangements have been made for participants who might not adequately understand verbal explanations or written information given in English, or who have special communication needs? (e.g. translation, use of interpreters etc.)

Having working in the oil and gas industry for over 10 years, and because the researcher is multi-lingual (speaks both English and Arabic) there will be no need for translation and interpretation.
6.6 What arrangements are in place to ensure participants receive any information that becomes available during the course of the research that may be relevant to their continued participation?

There will be constant updates to the participants because they will be given the email address and postal address where they will constantly be sending any requests or reversal of the consent.

6.7 Will the research participants' General Practitioner be informed that they are taking part in the study?

☐ Yes ■ No

If No, explain why not

N/A

6.8 Will permission be sought from the research participants to inform their GP before this is done?

☐ Yes ■ No

N/A

6.9 What arrangements have been made to provide indemnity and/or compensation in the event of a claim by, or on behalf of, participants for (a) negligent harm and (b) non-negligent harm?

There is no insurance policy that can be used to cover indemnity or compensation for participants claim; unless the University provides such a cover. Additionally, the sponsor may also provide employee insurance.
7. Data Protection and Confidentiality

7.1 Will the research involve any of the following activities at any stage (including identification of potential research participants)? (Tick as appropriate)

☐ Examination of medical records by those outside the NHS, or within the NHS by those who would not normally have access
☐ Electronic transfer by magnetic or optical media, e-mail or computer networks
☐ Sharing of data with other organisations
☐ Export of data outside the European Union
☐ Use of personal addresses, postcodes, faxes, e-mails or telephone numbers
☐ Publication of direct quotations from respondents
☐ Publication of data that might allow identification of individuals
☐ Use of audio/visual recording devices
☐ Storage of personal data on any of the following:
  ☐ Manual files including X-rays
  ☐ NHS computers
  ☐ Home or other personal computers
  ☐ University computers
  ☐ Private company computers
  ☐ Laptop computers (Personal)

Further details:

7.2 What measures have been put in place to ensure confidentiality of personal data? Give details of whether any encryption or other anonymisation procedures have been used and at what stage?

The measures taken are as follows:

(i) That the participants start by using self-created emails that may not need to have their personal addresses, numbers and personal work details. Except their official details will be needed and that needs to be anonymised
(ii) For any information that is essential, it is important to use a password management system such as Keepass software so that any information is kept safe and encrypted

7.3 Where will the analysis of the data from the study take place and by whom will it be undertaken?

The researcher is the main analysis of the information; and the supervisory team will be needing to view the analysis; hence the data will be kept on the laptop and or the desktop from the postgraduate office of the university. Access will be restricted by password.

7.4 Who will have control of and act as the custodian for the data generated by the study?

The researcher is the main person responsible for the data and for the management of access to the data.

7.5 Who will have access to the data generated by the study?

The researcher and the supervisory team.

7.6 For how long will data from the study be stored?

3 years

Give details of where they will be stored, who will have access and the custodial arrangements for the data:

All the information will be processed to make a data set on the laptop; and that will be pass-worded so that access will be restricted to the researcher and the supervisory team. This can be managed using a document management system that allows passwords to it; such as keepass software.

8. Reporting Arrangements
8.1 Please confirm that any adverse event will be reported to the Committee

I confirm that I will report any adverse effect to the Committee.

8.2. How is it intended the results of the study will be reported and disseminated?

A research project involving human participants is not regarded as ethical unless it is intended that the result should appear in a publication or be otherwise disseminated. In the case of a student project a dissertation or thesis is regarded as an appropriate report.

(Tick as appropriate)

- Thesis/dissertation
- Internal Report
- Peer reviewed scientific journals
- Conference presentations
- Written feedback to research participants
  - Presentation to participants or relevant community groups
  - Other/none e.g. Cochrane Review, University Library

8.3 How will the results of research be made available to research participants and communities from which they are drawn?

It will be in the best interest of the research participants to see the results of the research as it may impact the way of working in the refineries. Therefore the dissemination will be through the emails created for the research data collection

8.4 Has this or a similar application been previously considered by a Research Ethics Committee in the UK, the European Union or the European Economic Area?

- Yes
- No

*If Yes give details of each application considered, including:*
8.5 What arrangements are in place for monitoring and auditing the conduct of the research?

Research supervisors will monitor and audit the conduct of the research.

Will a data monitoring committee be convened?

☐ Yes  ■ No

What are the criteria for electively stopping the trial or other research prematurely?

Any unforeseen harm that cannot be resolved.

9. Funding and Sponsorship

9.1 Has external funding for the research been secured?

☐ Yes  ■ No

If Yes, give details of funding organisation(s) and amount secured and
9.2 Has the external funder of the research agreed to act as sponsor as set out in the Research Governance Framework?

☐ Yes  ☐ No  ■ Not Applicable

9.3 Has the employer of the Chief Investigator agreed to act as sponsor of the research?

■ Yes  ☐ No

9.4 Sponsor (must be completed in all cases where the sponsor is not the University)

Name of the organisation which will act as sponsor for the research:

University of Manchester

10. Conflict of interest

There is no conflict of interest at the time of application.
10.1 Will individual researchers receive any personal payment over and above normal salary and reimbursement of expenses for undertaking this research?

☐ Yes ■ No

*If Yes, indicate how much and on what basis this has been decided:*

10.2 Will the host organisation or the researcher's department(s) or institution(s) receive any payment of benefits in excess of the costs of undertaking the research?

☐ Yes ■ No

*If Yes, give details:*

10.3 Does the Chief Investigator or any other investigator/collaborator have any direct personal involvement (e.g. financial, share-holding, personal relationship etc.) in the organisation sponsoring or funding the research that may give rise to a possible conflict of interest?

☐ Yes ■ No

*If Yes, give details:*

11. Signatures of applicant(s)
12. Signature by or on behalf of the Head of School

The Committee expects each School to have a pre-screening process for all applications for an ethical opinion on research projects. The purpose of this pre-screening is to ensure that projects are scientifically sound, have been assessed to see if they need ethics approval and, if so, go to the relevant ethics committee. It is **not** to undertake ethical review itself, which must be undertaken by a formal research ethics committee.

The form must therefore be counter-signed by or on behalf of the Head of School to signify that this pre-screening process has been undertaken.

I approve the submission of this application

Signed by the Director of Research on behalf of the Head of School

Date