The influence of organisational typology, strategy, leadership and psychological forces on UK offshore oil and gas industry safety performance.

SPENCE, P.A.

2020

THE INFLUENCE OF ORGANISATIONAL TYPOLOGY, STRATEGY, LEADERSHIP, AND PSYCHOLOGICAL FORCES ON UK OFFSHORE OIL & GAS INDUSTRY SAFETY PERFORMANCE

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DBA **DECEMBER 2020**

THE INFLUENCE OF ORGANISATIONAL TYPOLOGY, STRATEGY, LEADERSHIP, AND PSYCHOLOGICAL FORCES ON UK OFFSHORE OIL & GAS INDUSTRY SAFETY PERFORMANCE

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A thesis submitted in partial fulfilment of
the requirements of
Robert Gordon University
for the degree of Doctor of Business Administration

December 2020

ABSTRACT

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For the degree of Doctor of Business Administration

'The influence of organisational typology, strategy, leadership, and psychological forces on UK Offshore Oil & Gas Industry safety performance'

The UK Offshore Oil & Gas Industry is recognised as having made significant safety performance improvement progress following the Piper Alpha disaster (6th July 1988), subsequent Public Inquiry, and 106 recommendations made by the Cullen Report. However, accidents continue to occur on offshore assets due to leadership and organisational failures, poor behaviours, lack of operating discipline, asset integrity challenges, and an absence of aligned safety strategy. Research was conducted through a strategic lens, looking across a typical Operator company's value chain, and going beyond the predominant technical and engineering safety focus. Utilising safety climate as a leading indicator of safety performance, research explored the ways in which organisational typology, strategy, leadership, and psychological forces contribute to safety performance on offshore assets. Research of this nature had not previously been conducted in the UK Offshore Oil & Gas Industry; triangulation of qualitative and quantitative data was utilised. Semi-structured interviews were conducted onshore with Managers and Supervisors to determine organisational typology make-up of the value chain, associated safety strategy, with consideration for leadership and the psychological forces dynamic of Human Factors. An Offshore Workforce Safety Study was deployed at seven offshore assets. Under Academic Licence, the study utilised proven and validated data collection tools: Authentic Leadership Questionnaire (ALQ); Psychological Capital Questionnaire (PCQ); and the Safety Climate Tool (SCT).

The research identified organisational typology patterns across the value chain. Operator and Contractor organisations were determined to typically identify as Defenders and Prospectors; Sub-contractors as Analyzers and

Reactors. Considering safety performance at the offshore assets as measured by safety climate perception, it was concluded that organisational typology had no influence. There was no statistically significant difference between the safety performance indicator of safety climate perceptions across the typologies associated with the Operator, Contractor, and Sub-contractor value chain groups. Strict compliance with the Operator control of work arrangements plus the consistent Operator safety message was concluded to be the mediating factor. Authentic leadership and psychological capital constructs were both demonstrated to be positively correlated with safety climate scores. Each of the seven assets studied returned 'Good' safety climate scores on a validated scoring system. However, there was no significant difference determined across Operator, Contractor, and Sub-contractor groups for safety climate scores by authentic leadership and psychological capital. Strict compliance with the Operator control of work arrangements plus the consistent Operator safety message was again concluded to be the mediating factor. Persisting with current compliance-based practices was determined to possess a limiting effect over the ability to evolve from 'Good' to 'Excellent' safety climate scores in future offshore asset operations. Derived from the research findings and conclusion, contributions to practice, knowledge and method were identified. Four specific recommendations were made for practice, plus four for future safety science research.

Keywords: Organisational Typology, Authentic Leadership, Psychological Capital, and Safety Climate.

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ACKNOWLEDGEMENTS

My transformative journey through the DBA experience has inevitably been shaped by a wonderfully diverse range of people: academics and scholars; fellow HSE professionals; onshore and offshore colleagues; also dearly loved family and friends. The entire part-time Post Graduate adventure has lasted almost a decade and, running in parallel with a busy and responsible full-time career, has been incredibly intense. It has also been completely life-changing both personally and professionally. Within my immediate circle of family and friends there has been the full spectrum of hatches, matches and dispatches. Life certainly did not cease going on around me while I was pre-occupied with research and study. That said, I wish my parents (Jenny and Bill) who passed-away long before I commenced studies and my father-in-law (John) who left us part-way through the process, had all been around to reflect on my journey's end. They were inspirational each in their own individual way.

The first person to wholeheartedly thank is my wife Rhona. The nature of my work has always included a significant amount of business travel but, adding insult to [her] injury, I have now spent most of the last decade pursuing some level of Post Graduate education in my *spare* time. Thank you, Rhona, for all your encouragement, love, and support; and patience with me too. We have two amazing sons who, despite being spectacularly different but equally wonderful characters, have the shared trait of determination to achieve at the highest level. Both highly qualified professionals, one is a Mechanical Engineer, and the other is a Trainee Lawyer. If ever I need to find inspiration I only need to look as far as them for a reason to never give-in or give-up. Thanks to you both Simon and Alexander, I am indebted.

My engagement with Robert Gordon University has been enriching in every respect. I am thankful for having been accepted during 2010 to complete a Post Graduate Certificate in Health, Safety and Risk Management, realistically the commencement of my DBA journey. Prior to enrolment, my life was slowly and subconsciously being suffocated by the rationally mechanistic nature of Health, Safety and Environmental management system standards. When I was introduced to the concept that every risk ultimately presents an opportunity, I became immediately hooked. During the follow-on Post

Graduate Diploma course, I had my initial encounter with Dr Moira Bailey of the Aberdeen Business School. For the first time during my studies, I was dealing with someone keen to explore concepts rather than merely work to a standards and regulatory driven formula. A year or so later and once accepted onto the DBA programme I had no hesitancy in seeking-out Moira to be my Doctoral Supervisor. Her declared passion is learning and development, which she brought in marvellous excess to our Supervisor-Researcher relationship. I cannot overstate the value of her input and wisdom in delivering me to the point of completion. I had no comprehension at the time but securing Moira as my Doctoral Supervisor would also deliver Professor Heather Fulford as the necessary second member of my Supervisory Team. Heather, as a professional researcher and educational leader has brought a wealth of research experience and knowledge to my DBA journey, primarily through her willingness to discuss and share experiences; I am eternally grateful to her. Working together, Dr Bailey and Professor Fulford have been a 'duffers' Dream Team.

I would like to sincerely thank the offshore personnel who kindly gave their time to complete my Offshore Workforce Safety Study Survey. Also, the onshore based Managers and Supervisors who volunteered to participate in semi-structured interviews. Without them all there would have been no data to analyse and no possibility of making an original contribution to safety science through research. Richard Tocher, thank you for your continued encouragement, faith, and support. Dr Nick Osborn, our challenging and robust conversations enriched my research activity and outcomes; I will always be extremely grateful.

Finally, I would like to dedicate this research to all victims of sexual abuse. It is important to remember that however, whenever, or wherever the abuse occurred we were not the perpetrators; we were the victims. Hopefully, all will find a path to healing; never give up. My path has meandered for almost fifty years and now includes a DBA. Truly, learning is an enriching, healing, and life-long experience.

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GLOSSARY OF TERMS

ALQ	Authentic Leadership Questionnaire
ALE	Asset Life Extension
HSE	Health and Safety Executive
HSL	Health and Safety Laboratory
MAH	Major Accident Hazard
OGUK	UK Oil & Gas
PCQ	Psychological Capital Questionnaire
PsyCap	Psychological Capital
SCiS	Step Change in Safety
SCT	Safety Climate Tool
SPER	Student Proposal Ethical Review
UKCS	United Kingdom Continental Shelf

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CHAPTER ONE
RESEARCH INTRODUCTION

1.0 INTRODUCTION

This chapter serves to provide the reader with a comprehensive background to the thesis, introduce the research aim, questions, and objectives, present a synopsis of the research design and methodology, plus highlight the significance of the study. It also provides a chapter outline for the remainder of the thesis.

1.1 BACKGROUND AND RESEARCH AIM

Accidents and incidents in the workplace, for example Major Accident Hazard (MAH) events such as explosion and fire or occupational safety events such as slips, trips and falls, are acknowledged to severely deteriorate human capital, essential to organisational competitiveness, innovativeness, and economic success (Marimuthu et al., 2009; Unger et al., 2011; Diaz-Fernandez et al., 2014; Kottaridi et al., 2019) and at the same time negatively affecting productivity (Fernandez-Muniz et al., 2009). Considering organisations to be designed through strategic choices, something that was argued early by Child (1972), safety strategy considerations may be considered as an important strategic element for inclusion in overall business strategy. With that in mind, the research was conducted through a strategic lens, going beyond the predominant technical and engineering focus of organisations where frequently safety is considered proven by the absence of accidents and incidents.

Safety management in organisations is considered heavily dependent on management and workforce beliefs and assumptions concerning organisational behaviour and safety, thus safety can be viewed as a dynamic and emergent property of an organisation, including engineering, social and technological aspects (Reiman et al., 2015). Further, the concept of safety and its management was considered adaptive and evolving in nature by Obolensky (2016). In formulating a proposal for the current research and through literature review, there appeared to be little evidence of safety

science research on the topic of safety strategy. However, in the absence of a strategy for safety with alignment to overall business strategy, it is unclear how positive safety performance can be consistently delivered to the benefit of organisational competitive advantage (Fernandez-Muniz et al., 2009). A clear rationale for the research study subsequently emerged with a determined focus to provide an original contribution to assist with closure of the perceived safety-strategy gap in safety science research literature.

Aligned with the perceived safety-strategy gap and from a from a human capital perspective, the UK's Health and Safety regulator acknowledges that everyone can make errors no matter how well trained and motivated they are. However, the consequences of such human failure in the workplace can be extreme. Analysis of accidents and incidents provides evidence that human failure contributes to almost all accidents and exposures to substances hazardous to health. Many major Oil & Gas Industry accidents were initiated by human failure (Reason, 1997; Hopkins, 2012; Decker, 2014; Flin et al., 2015). To avoid accidents and ill-health, organisations need to strategically manage human failure as robustly as the technical and engineering measures they use for that purpose (Decker, 2011). This served to direct the research into considering safety as a social construct within the context of organisational typology and organisational strategy.

In the UK, the explosion and fire that destroyed the Piper Alpha oil platform on 6th July 1988, resulting in the deaths of 167 offshore workers, provided the worst offshore oil and gas industry disaster in terms fatalities. The Cullen Report (1990) resulting from the Public Inquiry has significantly influenced the management of health and safety for offshore workers during the past 25 years. The enquiry made 106 recommendations in five key areas: regulatory systems for the UK offshore industry; management systems and control of work, hydrocarbon control, management of emergencies, evacuation, and rescue; and workforce engagement. Improvements generated following the Cullen Report have generally been credited with raising safety standards within the UK industry. The UK Oil & Gas Piper 25 Conference held during June 2013 had an agenda to reflect, review, reinforce and re-energise management of offshore safety. A Review of the Cullen Recommendations questioning their current relevance. The conclusion was that in the UK

industry accidents and incidents still occur for 'old' reasons. To meet these challenges, it was stressed as essential for organisations working in the industry to develop and implement appropriate business strategies, supported by effective leadership. Judith Hackitt CBE, Chair of the Health and Safety Executive stated that "*there are no new accidents. Rather there are old accidents repeated by new people*" (Hackitt, 2013).

The conclusion resonated that the industry remained predominantly focused on the engineering and technical aspects of safety; still viewing safety as proven through lagging indicators, the absence of accidents and incidents. The UK Regulator called for appropriate business strategies, highlighting the need for safety to be included formally as an element of overall organisational strategy. This was confirmed by Broadribb (2015) when considering what has really been learnt twenty-five years on from Piper Alpha was that in the UKCS accidents still occurred on offshore assets due to a blend of leadership and organisational failures, poor behaviours, and operating discipline, deficient asset integrity, and an absence of coherent safety management (strategy). By viewing safety strategy as a dynamic and emergent property of an organisation, opportunities may subsequently present to stimulate safety performance improvement with a commensurate positive affect on organisational productivity and competitiveness. Given the complex and varied make-up of the UK Offshore Oil & Gas industry value chain, the Researcher considered it unlikely that a one-size fits all safety strategy would be possible. Having already established that safety may be viewed as a dynamic and emerging property of an organisation, any developed strategy will most likely possess a uniqueness reflecting each organisations' emergent engineering, social and technological aspects. Across the value chain there are many examples where different organisations provide the same products and services to the industry customers; here there may be similarities of process, structure, and strategy. Therefore organisational [strategic] typology emerged as a research topic of interest. Piper 25 highlighted the need for effective leadership in support of appropriately selected business strategies. This element of conclusion framed a key research area; for highly complex organisations working in hazardous environments is there a predominant style of leadership that promotes positive safety behaviour, through the effective implementation of safety strategy as an aligned element

of business strategy? At an individual level, what characteristics require to be present to ensure that safety policies and procedures are consistently followed, all with an acute level of hazard awareness to detect changes and emerging threats in the working environment? With these considerations, an overall research aim was established to:

'*Explore the ways in which organisational typology, strategy, leadership, and psychological forces contribute to safety performance'.*

When the research was significantly underway, a Safety 30 industry conference was held during June 2018; a two-day event to mark the 30th anniversary of the Piper Alpha disaster. Lord Cullen presented an address containing a stern reminder of the dangers of complacency, particularly the dangers associated with not recognising or effectively acting upon warning signals. The examples highlighted included: Texas City Oil Refinery, 2005; Buncefield Oil Storage Depot, 2005; and Deepwater Horizon, 2010. These disasters were multi-faceted rather than purely engineering and technical in root cause, each giving rise to incident investigations, reports and academic studies illustrating [amongst other considerations] Human Factors (HF), organisational plus social contributing factors. The consideration of Safety 30 indicated that the conclusions of Hackitt (2013) from the Piper 25 Conference plus Broadribb (2015) had not been fully acted upon; there remained propensity for further UK Offshore Oil & Gas Industry disasters. In all regards, Safety 30 reinforced the originality and continued relevance of the established research aim.

1.2 HAZARDS IN THE OIL & GAS INDUSTRY

The global and industrialised Oil & Gas Industry may be considered relatively modern, dating from the 19th century and the exploitation of the Baku (Azerbaijan) oilfields in 1846. By the year 2000, hydrocarbons (oil and gas) were the most important derivation of power in the world economy (Stoneham, 2000), especially in modernised western societies. Out of commercial necessity, offshore oil and gas production platforms are usually designed in as compact a layout as possible, with a high density of processing equipment and living space (Khan, Sadiq, and Husain, 2002). Hazards are

present in any process involving hydrocarbons especially on offshore installations. Any accident resulting in fire and explosion may lead to the total loss of an offshore installation, as well as human life, e.g. Alexander Kielland - 1980, Piper Alpha – 1988, Mumbai High – 2005 and Deepwater Horizon - 2010. The direct effect of fire and explosion to human life may be catastrophic and so may be the impact on the physical installation itself. Furthermore, oil and gas organisations are complex systems that are continually changing. Changes are typically in response to the external environment, e.g. market conditions, competition, government legislation, and shareholder expectations. Change may also by initiated from the internal environment, e.g. from within the social organisation. For offshore installations specifically, change may involve the production processes, technology, and personnel; all such change can invalidate, to a degree, prior hazard identification and risk assessment outcomes. If hazards are identified and associated risks assessed on a continual basis then such changes should be picked up explicitly to avoid accident and incident situations from evolving to catastrophic levels. However, the continuation of major oil and gas industry accidents occurrences worldwide (e.g. Alexander Kielland, Piper Alpha, Mumbai High, and Deepwater Horizon) serve to highlight the need for improved safety performance within hydrocarbon producing organisations.

1.3 UK OFFSHORE OIL & GAS INDUSTRY SAFETY PERFORMANCE TRENDS

Specifically considering the UK Offshore Oil & Gas Industry, and as stated previously, improvements generated following the Cullen Report are generally credited with raising safety standards within the UK Offshore Oil & Gas Industry. Oil & Gas UK's annually published Health & Safety Report documents this overall improvement, as evidenced by the key performance data and trends. Figure 1.1. illustrates that since 2006-07 there have been seven work-related fatalities. This is significantly lower than the nineteen fatalities occurring across the previous decade. Similarly, in Figure 1.2, the specified injury rate decreased to just under 73 per 100,000 workers during 2016, its lowest recorded level. Furthermore, the over-seven-day injury rate reached a historic low during 2015, increasing slightly again during 2016 and 2017.

Year	Number of Fatalities	Year	Number of Fatalities
1996-97	2	2006-07	2
1997-98	3	2007-08	0
1998-99	1	2008-09	0
1999-00	2	2009-10	0
2000-01	3	2010-11	0
2001-02	3	2011-12	2
2002-03	0	2012-13	0
2003-04	3	2013-14	2
2004-05	0	2015	0
2005-06	2	2016	1
		2017	0

Figure 1.1 Fatal Injuries Offshore - Source OGUK (2018a)

Figure 1.3 illustrates that the number of major and significant releases have also been reducing since the recorded peak in 1997, with the twenty-three events recorded in 2016 being the lowest year on record. The key performance data and trends demonstrate improvement in safety performance over time, but also that further scope for improvement persists given the continued presence of hydrocarbon hazards plus a challenging work environment. There remains, however, no room for industry complacency with new challenges that did not necessarily present at the time of the Piper Alpha disaster. The UK industry has an increasingly ageing infrastructure and a mature basin that requires the execution of new and potentially untried

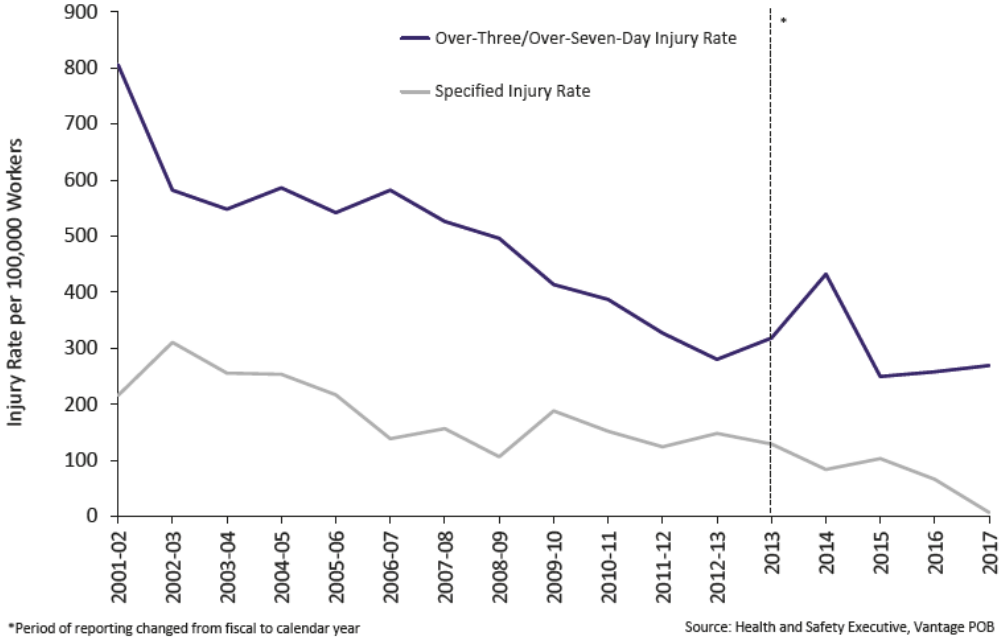

Figure 1.2 Over-Seven-Day and Specified Injury Rate per 100,000 Workers - Source: OGUK (2018a)

technologies for hydrocarbon extraction. Decommissioning activity in the UK sector is predicted to increase over the next ten-plus years, presenting further challenges within the industry to: prevent major accident hazard occurrence by effectively managing asset integrity; and maintaining a positive focus on safety through completion of the decommissioning process (OGUK, Decommissioning Insight 2018b).

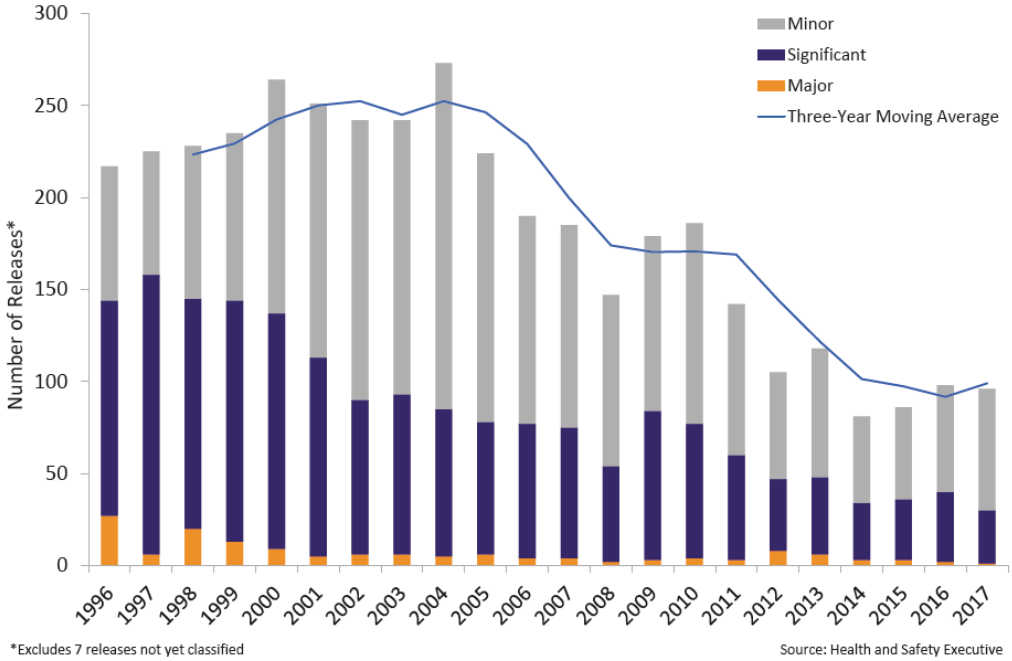

Figure 1.3 Number of Process Hydrocarbon Releases Offshore - Source: OGUK (2018a)

Consequently, there are now different business risk issues to be considered by both Operating, Contracting and Sub-contracting companies. The UK Regulator considers that Human Factors (HF) is clearly an issue for the industry (Hackitt, 2013). They may influence outcomes in each of the five key areas of recommendation made by Lord Cullen, most specifically management systems and control of work. Lest the industry forget Lord Cullen's most recent reminder [at Safety 30] concerning complacency and the dangers associated with not recognising or effectively acting upon warning and weak signals.

1.4 HUMAN CONTRIBUTION TO THE UK OFFSHORE OIL & GAS INDUSTRY

Human contribution is substantial to the UK Offshore Oil & Gas Industry, with 49,079 people travelling offshore during 2018 (OGUK, 2019a), with almost 80 per cent working for Contractor or Sub-contractor companies. an offshore

population of 29,700 full time equivalent (FTE) workers (HSE, 2018), accounting for 4.8 million working days offshore. This population is spread across 143 manned operational assets, who in addition, provide support to 118 normally unmanned installations, typically through helicopter flying campaigns. In addition, there are a further 41 non-operating assets that require periodic in-field intervention and inspection. This workforce faces daily challenges of a hostile environment in addition to complex and highly physical process demands related to the extraction, containment, and transportation of hydrocarbons. In addition, approximately fifty percent of fixed platforms have now aged to beyond their original design life. The HSEb (2014: 13) noted that ageing is not limited to hardware but extends to "*procedures, software, control equipment, and perhaps most importantly to the skills and experience of people working in the offshore industry, and the need to bring new people into the industry to be trained to manage future challenges*." It can be plausibly deduced, therefore, that ageing assets have the potential to exacerbate some elements of operational and process safety thus presenting potential serious consequences for personal and commercial risk, particularly if not appropriately managed. Additionally, the potential for: loss of hydrocarbon containment; asset failure; collision; well plug and abandonment failure; loss through incident in well intervention processes; or loss of well control; must be considered as dynamic, complex, and costly. In addition to life extension projects there are an excess of 150 decommissioning projects across the UK industry. Decommissioning is an activity that is expected to have a duration beyond at least 2025 (Oil & Gas UK, 2018). As the level of technology continues to expand, driving complexity of processes and systems, any subsequent major accidents could be catastrophic and may even result in commercial extinction for organisations involved in industry value chains.

In recent years, several engineering approaches have been developed and implemented to generate safety improvements. For example, '*inherent safety*' principles have been applied to the conceptual and detailed design of offshore platforms (Dalzell, 1998; and Kletz, 1998). This approach has the advantage that it addresses the source of potentially hazardous situations. However, human and organizational factors remain equally important issues to manage for improved safety performance (Reason, 1990; O'Dea and Flin,

2001; Mikkelsen, Ringstad and Steineke, 2004; Nivolianitou, Leopoulus and Konstantinidou, 2004; Hughes and Kornowa-Weichel, 2004; Adie et al., 2005; plus Attwood, Khan and Veitch, 2006). This latter point is notable since in UK industry a significant majority of major accidents and incidents include HF as a critical feature. The UK Regulator consider that human failures, not mechanical failure, or environmental intervention, are responsible for up to 80% of all types of accident and feature in almost every major accident. In this environment, HF become increasingly critical. Where safety is concerned "*mastery of human factors is necessary when implementing safety management in complex systems*" (Teperi and Leppanen, 2011). This perspective is supportive of Dekker's (2011) consideration that to avoid accidents and ill-health, organisations need to strategically manage human failure as robustly as the technical and engineering measures they use for the same purpose.

1.5 HUMAN FACTORS AND SAFETY

Within the UK offshore Oil & Gas industry Human Factors are typically referred to as being:

"*environmental, organisational and job factors, and human and individual characteristics, which influence behaviour at work in a way which can affect health and safety*". (HSE, 1999).

However, within broader academic research, a consistent definition of the HF term continues to prove elusive. Korolija and Lundberg (2010) record that HF is a term frequently misused in media reporting of accidents. The unfortunately resultant and misplaced interpretation is one singularly related to human failure. Korolija and Lundberg (*ibid*) also confirmed through their studies that the lack of consensus over the HF definition between professional accident investigators further highlights the inconsistencies of HF conception. For research purposes, and to gain traction within organisational strategy, qualified support is provided for the definition propounded by Woods and Decker (2000) who defined HF as the:

"*intersection between people, technology and work, with the major aim to find areas where design and working conditions produce human error*."
This definition narrowly focuses on human error. The alternative definition of HF, offered by the International Ergonomics Association (IEA, 2000) focuses on 'optimising performance' rather than 'error' and considers the 'interactions' between people was preferred for research purposes:

"*the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theoretical principles, data and methods to design in order to optimise well-being and overall performance.*"

Dul and Neumann (2009) consider from this definition that HF has both a social (well-being) and an economic (performance) goal. Dul et al. (2012) conclude further that: HF pursues a systems approach; is design driven; and focuses on performance and well-being. Hollnagel (2014) considers that, as outcomes, the social and economic goals of HF will generally be realised on two quite different timescales. Achievement of the economic goal through performance improvement may be realised through well-known mechanisms, with insignificant delay and limited uncertainty. However, the relationship between HF and well-being (a psychological and physiological state) is indirect and may involve considerable unknown delays. Dul and Nuemann (*ibid*) suggest that by connecting HF to organisational strategy, a positive motivation for the application of HF may be created. Such a perspective may promulgate improvements in overall business system performance as well as in safety performance.

1.6 STRATEGY AND SAFETY

Given the perspective from the UK Regulator, consideration was given through research to exactly what constitutes and represents appropriate business strategies to ensure effective safety management. For several decades, the formulation of strategy and strategic management has been an important element within the private sector industries (Grandy and Mills, 2004). Strategy is seen as the key to successful business operations through increased competitiveness (Finlay 2000; and Grant, 2003; and Johnson et

al., 2011). Strategy may be visualized at three distinct hierarchical levels: corporate; business; and functional (Lampel et al., 2014). Theories of strategic management recognise the importance of internal activities, resources, or capabilities as potentially important sources of creating value (KPMG, 2010; and Buller and McEvoy, 2012). The basis of strategic management theory has been shaped by several key authors, for example Chandler (1962) and Rumelt (1974). Chandler (*ibid*) chronicled the evolution of major American corporations from single product-market entities into vertically integrated ones with multi-business scopes. Rumelt (*ibid*) further developed Chandler's propositions by developing a more refined classification of diversification strategies. Ultimately, strategic management concerns choosing a unique position for a company, i.e. doing things differently or better than competitors, and in a way that typically lowers costs or better serves customer needs (Porter, 1979). The intention is to create a discernible competitive advantage (e.g. Penrose, 1959; Mintzberg, 1978; Grant, 1991). Central to strategic management is the strategy itself. According to Mintzberg (1978: 935) "*strategy in general, and realized strategy in particular, will be defined as a pattern in a stream of decisions*". In his study he argues that "*the field of strategic management cannot afford to rely on a single definition of strategy*". One definition would be that corporate strategy explains the meaning and vision of a company to internal and external stakeholders while defining the boundaries of corporate policies, and thus contributes to a better understanding of corporate identity and culture (Mintzberg, 1987). Mintzberg et al. (1998) described ten different schools of thought that focus on the strategy formation process and emerge in management practice. Johnson et al. (2011) stated that corporate strategy is the combination of strategic analysis, choice, and implementation. Hill et al. (2015) described the analysis of internal and external company environments and the selection of corporate strategies as strategy formulation, whereas strategy implementation means putting the selected strategies into action.

Moreover, considering an organisations total environment (internal and external) the concept of value chain became relevant. The value chain represents "*the full range of activities which are required to bring a product or service from conception, through the intermediary phases of production…., delivery to final consumers, and final disposal after use*" (Kaplinsky, 2000:

121). To achieve a value proposition, it is essential that an organisation effectively manages the internal primary activities of their value chain plus the external contracted secondary activities; particularly those that relate directly to profitability and future competitiveness. In concurrence with Porter's (1985) seminal emphasis on the need to effectively link the integrated internal value chain activities, i.e. finance, accounting, marketing, production, research, development, and HSE management, to generate success through overall organisational strategy: a key feature of the conducted research.

Further, and from a safety perspective, the value of strategic performance management is reflected in effective hazard identification, management and the absence of accidents and incidents (both major hazard and occupational). As such, successful strategic performance management is recognized as an essential activity in modern and dynamic business environments (Misankova and Kocisova, 2014). Aaltonen and Ikavalko (2002) concluded that the key (and challenge) to effective strategy implementation lies in the cultural and communication aspects of organisations. This highlights the need for strategic leadership to provide for effective communication and the development of an appropriate organisational culture, inclusive of safety culture. After all, at Piper 25, the UK Regulator called for appropriate business strategies supported by effective leadership and to stop having 'old' accidents with new people (Hackitt 2013). Boal (2004: 1504) defined strategic leadership as making *"sense of and gives meaning to environmental turbulence and ambiguity and provides a vision and road map that allows an organisation to evolve and innovate."* Again, from a safety perspective, such leadership may be successful in facilitating effective management of hazards; both current and emerging. It may therefore be reasoned that effective strategic safety management and decision making, when combined with line of sight (LOS) considerations (Boswell, 2006), would be effective in connecting functional level HF activity with business and corporate level goals and objectives. A consistent HF definition aligned with a strategic '*safety message*' and taken in combination with effective leadership may lead to increased safety performance for the industry.

1.7 PSYCHOLOGICAL FORCES ASPECT OF HUMAN FACTORS

Storseth et al. (2014) in re-analysing the Hopkins (2012) study of the Deepwater Horizon accident concluded that psychological forces may have contributed to risk transfer across established safety barriers (technical, procedural, and organisational). The specific psychological mechanisms that contributed to the Deepwater Horizon barrier failures were: inadequate hazard identification; consensus-mode decision making; confirmation bias; warnings normalization; and groupthink. Storseth et al. (*ibid*: 54) defined these mechanisms as the "*dynamics of social interaction*" and considered the triangulation of "*persuasion, pressure and power*" as capable of creating conflict with the planned arrangements for safety defences and helping to defeat the in-place barriers. This highlighted psychology as a causal element of the Deepwater Horizon tragedy along with both organisational and technical contributions. These psychological forces are consistent with the notion that majorities can influence individuals even in the most inappropriate or dangerous of circumstances due to human social cognition being "*primarily and involuntarily cooperative at the implicit level*" (Stein, 2013:788). People appear to be involuntarily directed by the internal states and belief of others (Kovacs, Teglas and Endress, 2010) where, despite the existence of conscious conflict, the pull of the group provides a tendency towards conformity.

The "*dynamics of social interaction*" as well as having the potential to produce safety barrier defeating forces are also integral to organisational [safety] learning. Here learning occurs through on-the-job experience, working alongside colleagues, hearing their stories, and getting feedback (Duguid, 2005). This perspective on safety learning and the development of expertise is supported by Malsen (2014: 88) who observed that the "*social science literature on expertise development strongly suggests that it is more than a matter of formal learning opportunities*". Further, Nesheim and Gressgard (2014) concluded that knowledge sharing has a positive effect on individuals' actions in terms of safety. HF is a very broad concept, however, the importance of the learning through social interaction highlights psychological forces (positive and negative) as a specific aspect HF worthy of research, particularly their inclusion in safety strategy as an integrated element of overall business strategy.

1.8 SAFETY CULTURE AND STRATEGY IMPLEMENTATION

As previously stated, Aaltonen and Ikavalko (2002) concluded that the key (and challenge) to effective strategy implementation lies in the cultural and communication aspects of organisations. This highlighted the need for strategic leadership to provide for effective communication and the development of an appropriate organisational culture, of which safety culture is an important aspect. Martin (1985) considered culture to be emergent within organisations and not something managed into being. Hofstede et al. (2010) considered organisational culture to be a blend of symbolic and material artefacts. Schein (2017: 10) considered that the concept of culture implies "*structural stability, depth, breadth, and patterning or integration that results from the fact that culture is for the group a learned phenomenon just as personality and character for individual learned phenomena*". Schien (*ibid*) has evolved his thinking such that culture has a dynamic definition and is constantly evolving. This dynamism is a theme reflected in the Miles and Snow (1978) study of organisational strategy where one objective was to develop an understanding of the process by which organizations continually adjust to their environments, the researchers identified deduced an 'adaptive cycle' within business organisations. In addition to identifying four seminal typologies, they observed a perpetual cycling through three sets of decision making: the entrepreneurial problem; the engineering problem; and the administrative problem.

Given the reflections of adaption and dynamism for organisational [and safety] culture the researcher recognised a key alignment with the social constructionist approach, particularly considering its extensive emphasis on everyday interactions between people and how they use language to construct their reality. It is concerned with how knowledge is constructed, communicated, and understood as a pivotal component of culture as well as strategy development and deployment. Thus, the social constructionist approach provided an appropriate under-pinning for the research.

1.9 RESEARCH QUESTIONS

During previous research (Spence, 2013) it became evident that there was a paucity of research literature considering HF as an aligned and integral element of business and/or safety strategy. Taken together with current concerns regarding ageing assets and continued safety issues within the industry, there was genuine potential for both topicality and originality of purpose in a research undertaking. Considering firstly HF as an inclusion within safety strategy along with effectiveness of implementation, and secondly through the relevant literature, it may be possible to produce an innovative and potentially important advance in safety science: assessing the impact of HF on safety strategy with corresponding increases in business effectiveness and safety performance improvement. The output from such research may ultimately benefit the industry through an increased understanding of HF within organisational safety strategy, leading to a reduction in the misconception that HF only equates to simple human failure and blame; perhaps ultimately leading to the demise of the '*scapegoat*' phenomenon in accident and incident investigations. For the research sample population specifically, any identified threats to the future safety performance will lead to robust recommendations for short, medium, and longer-term improvement actions.

Attempting to improve understanding of how the dynamics of social interaction can be capable of creating conflict with the planned safety defence arrangements thereby helping to defeat the in-place barriers, the research draws focus to [the Miles and Snow] organisational typology as a determinant of safety strategy through to its execution at the asset workforce level. Within the UK Offshore Oil & Gas Industry value chain, the Operator, Contractor and Cub-contractor typologies were deduced to likely specify a *priori* of safety strategy constructs to be expected. Here, strategy implementation was considered an antecedent of safety performance. Therefore, the inclusion or non-inclusion of elements to positively influence the dynamics of social interaction within safety strategy represent drivers, or inhibitors, for continual improvement in safety performance.

As stated in section 2.0, the research aim was to '*Explore the ways in which organisational typology, strategy, leadership, and psychological forces contribute to safety performance*'.

Consequently, the research process commenced with the generation of six general focus research questions that flowed from the research idea (Saunders et al., 2009) and aim. These were subsequently utilised to direct the literature review (Bryman, 2012) and provide the basis for research objective development thereby leading to greater specificity in the research to be undertaken. The research questions established were:

1. What are the organisational typologies displayed by value chain organisations 'Operator', 'Contractor', and Sub-contractor'?

2. To what extent is safety strategy, with HF content, included as an aligned element of organisational business strategy for the differing organisational typologies?

3. What is the relationship between workforce psychological capital and organisational typology within value chain organisations?

4. What is the relationship between organisational typology and safety leadership style within value chain organisations?

5. What is the relationship between organisational typology and perceived workforce safety climate at offshore assets involved in Exploration, Operations, Asset Life Extension and Decommissioning?

6. What effect does the Operator company safety message(s) have in creating alignment between all involved parties, irrespective of typology, to deliver acceptable safety performance?

1.10 RESEARCH OBJECTIVES

Saunders et al. (2009) consider that to deliver the necessary level of precision with research, the development of research objectives is required to stimulate

a greater degree of rigorous thinking, derived through use of more formal language. Therefore, the six established research questions were operationalised into five research objectives with specific reference to the UK Offshore Oil & Gas Industry Exploration, Operating, Asset Life Extension and Decommissioning lifecycle phases:

1. To determine the extent of the influence exerted by organisational typology on the construction of safety strategy as an aligned element of overall organisational strategy. (From research question 1).

2. To establish whether the psychological forces component of Human Factors is embraced within constructed safety strategies, considering psychological capital as an antecedent of safety focused behaviour. (From research questions 2 and 3).

3. To describe the organisational typology associations with specific styles of safety leadership at the operational level on offshore assets during the lifecycle phases. (From research question 4).

4. Determine how the preceding three aspects of safety strategy implementation combine to produce individual asset safety climate profiles. (From research question 5)

5. Determine whether safety performance as reflected through safety climate perception is driven by individual organisational typologies or by the Operator company overarching safety message. (From research question 6).

On acceptance of the research proposal, a Starter-Research Model, Figure 1.4, was conceived. This was an initial guide to be used alongside the research questions to frame the research scope for literature review and eventual necessary synthesis. The developed model incorporated the principle of continuous improvement, central to effective functioning of three highly relevant management system standards associated with effective safety performance: ISO 45001:2018 (Occupational health and safety

management systems – Requirements), ISO 14001:2015 (Environmental management) and ISO 9001:2015 (Quality management).

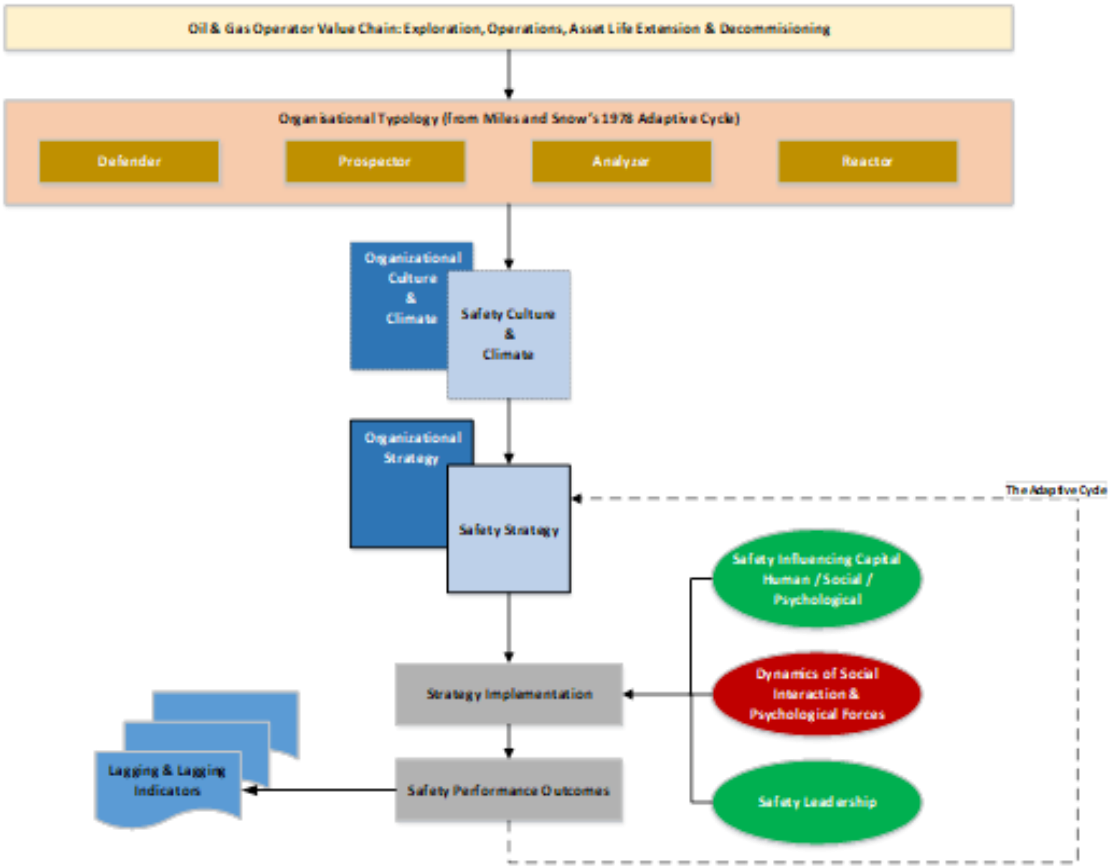

Figure 1.4 Starter-Research Subject Model - Source: Author

Following establishment of the starting model, subsequent completion of literature review, and finally the literature synthesis the research title evolved to be:

'*The influence of organisational typology, strategy, leadership, and psychological forces on UK Offshore Oil & Gas Industry safety performance'.*

As the research progressed, the initial model (Figure 1.4) became superseded by the final Literature Synthesis depicted in Figure 2.8 of chapter 2.

1.11 ANTICIPATED RESEARCH OUTCOMES

This DBA research was constructed to contribute significantly at both academic and UK Offshore Oil & Gas Industry levels through an advancement of the theory and understanding of safety strategy (its construct and

implementation) linked to organisational typology, with a specific focus on the psychological dynamics of HF plus safety leadership. The overarching intent was to add to the body of safety science knowledge that currently exists plus be of interest to a wide range of stakeholders, including Safety Practitioners and Oil & Gas Business Strategists. By satisfying the five established research objectives, several value-adding outcomes were anticipated for safety science research along with practical work-place applications; all intended to facilitate improved safety performance outcomes on offshore assets in the UK Offshore Oil & Gas Industry:

1. Identification of new areas and topics for future safety science research.

2. Recommendations for:

    a. Enhancement of Supplier and Sub-contractor evaluation and selection processes to maximise alignment across the value chain, leading improved safety performance at offshore assets

    b. Safety leadership development to deliver improved leader-follower relationships resulting in improved safety performance at offshore assets.

    c. Developing the psychological strength of the offshore workforce, with a resultant improved ability to resist the adverse dynamics of social interaction (position, pressure, and power) thereby sustaining safety barriers and defences in depth.

    d. Safety strategy approaches to deliver improved alignment with overall business strategy, thereby enhancing organisational competitiveness through improved safety performance.

1.12 OUTLINE OF THE THESIS

The thesis has been presented across six chapters as outlined in Figure 1.5: an introduction (Chapter 1), a critical literature review (Chapter 2), the research methodology (Chapter 3), quantitative and qualitative research

findings (Chapter 4), discussion and sense-making (chapter 5) and finally conclusions, original contribution, and recommendations for practice plus future safety science research (chapter 6).

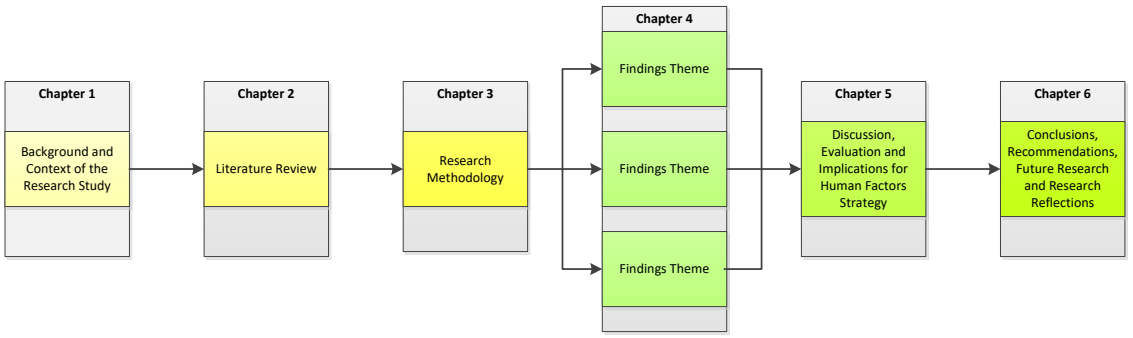

Figure 1.5 Structure of the Thesis - Source: Author

The first chapter provides an introduction and background to the research study along with context, significance, and potential safety science contribution. Chapter Two presents a comprehensive review of the relevant literature informing the research study. It begins with an overview of the terms Human Factors, Leadership, Strategy and Value Chain in the context of this study – that of the UK offshore Oil & Gas industry. The chapter subsequently provides a summary of the contributory nature of Human Factors in implementing and maintaining a proficient and effective safety climate and culture in the UK offshore Oil & Gas industry through inclusion as an aligned component of overall organizational strategy. Additionally, the chapter provides a summary of the contribution from organisational safety strategy formulation, alignment, and effective leadership to the management of occupational as well as major accident hazards, plus the subsequent reduction of risk.

Chapter Three outlines the research design and methodology for the study. The theoretical and methodological assumptions are discussed illustrating how the between-methods triangulation approach was appropriate for this study. A description of the method employed to obtain and analyse the data is provided along with the steps taken to ensure ethical issues were upheld and rigour and validity were maintained throughout this study. The research subjects are introduced in this chapter as well as a discussion of how they were selected.

Chapter Four contains the outcomes of the research study components and methodological triangulation. Within the chapter, themes relating to HF psychological forces, strategy conclusion and safety performance outcomes are developed

Chapter Five presents a discussion of the findings and the implications in respect of the aim, and research objectives.

Chapter Six finally details the research conclusions, considering the research aims, and objectives. Additionally the chapter outlines recommendations for organisations working in the UK Offshore Oil & Gas Industry striving to develop and implement appropriate business strategies supported by effective leadership to ensure that accidents and incidents no longer occur for 'old' [Piper Alpha-era] reasons. The chapter also details the unique contribution made to safety science research and proffer some suggested areas for future research.

1.13 CHAPTER SUMMARY

The first chapter provided the reader with an introduction, background, and context to the accepted research study along with the identified potential contribution to the safety science body of knowledge. The chapter commenced with recognition that accidents and incidents in the UK Offshore Oil & Gas Industry workplace are acknowledged to deteriorate, human capital and negatively affect productivity and competitiveness. Considering safety to be an important element for inclusion in overall business strategy, and in observing both the 25th and 30th anniversaries of the 1988 Piper Alpha disaster, the UK's Health and Safety Executive recognised the UK Offshore Oil & Gas Industry to still had accidents for *old* reasons. The UK Regulator stressed that it was essential for the Industry to develop and implement appropriate business strategies, supported by effective leadership. Following the Cullen Report into the Piper Alpha disaster it has become clear that safety performance in the UK Offshore Oil & Gas Industry has improved through reduced: fatal injuries; over seven-day-injuries; and process hydrocarbon releases. However, the UK Regulator maintains a concern of Industry complacency and urges organisations not to ignore the dangers associated

with failing to recognise or effectively act upon weak signals. Acknowledging the human contribution to the UK Offshore Oil & Gas Industry remains significant, there is recognition from the UK Regulator that human failure accounts for up to 80% of accidents and routinely feature as a contributing factor to major accidents; mastery of Human Factors becomes essential if the Industry is to stop having accidents for *old* reasons.

The chapter also considered the evolution of strategy formulation and strategic management and gave recognition to the consideration that the key (and challenge) to effective strategy implementation lies in the cultural and communication aspects of organisations that are both social and dynamic through evolution and implementation. Dynamism was reflected through the seminal Miles and Snow (1978) study of organisational strategy and how organisations continually adapt to their environments. From a social perspective, Storseth et al. (2014) demonstrated through a re-analysis the 2010 Deepwater Horizon disaster that the dynamics of social interaction (plus the associated psychological forces) possessed an ability to transfer risk across, and defeat, in-place safety barriers.

From the provided background and context, the research aim, six research questions and five research objectives were established. The following chapter will provide the reader with a thorough description of the critical literature review conducted to satisfy the research aim, questions, and objectives.

*** *** ***

CHAPTER 2
CRITICAL LITERATURE REVIEW

2.0 INTRODUCTION

This second chapter encompasses the literature review undertaken to address topics considered significant to the research conducted and in support of the established research aim and objectives. Its purpose is to provide the reader with a clear understanding of the critical appraisal and synthesis of the current body of knowledge related to the research topic leading to the achievement of the research aim through satisfying the research questions and objectives. The chapter also serves to facilitate the identification of gaps leading to incremental contributions to the existing safety science knowledge base.

2.1 LITERATURE REVIEW CONTEXT

Interest in organisational strategy as a concept relative to structure and management processes, how these aspects drive competitiveness and business success, has grown significantly during the past five decades (e.g. Finlay, 2000; Grant, 2005; and Johnson et al., 2011). A considerable amount of research and writing has also been undertaken considering the organisational dimension of accidents and incidents in the workplace (e.g. Flin et al., 2015; and Reason, 2016). There is, however, a paucity of research within the fields of strategy and safety to develop an understanding of how strategy contributes to the capability of high-risk socio-technical organisations to function competitively and effectively within safe operating parameters. The current research is solely focused on the relationship between organisational strategic typology and achievement of positive safety performance outcomes within the UK Offshore Oil & Gas Industry, given that accidents within this sector can lead to devasting consequences for individuals, the environment and for business survivability itself. Furthermore, the research specifically considers the psychological forces dynamic of Human Factors in safety plus their reflection in organisational strategy.

The scope of literature review included both empirical and theoretical works accessed through published journals and textbooks along with grey literature contained in regulatory and industry body publications. Following the provision of research context, the literature review became structured in a manner that elicited emergent, interdependent, and pivotal concepts reflecting distinct themes of the literature review conducted. The concepts and emergent themes are illustrated in Figure 2.8. Literature Synthesis. The literature review methodology took an almost 'snowball sampling' approach to information extraction, providing an opportunity for the Researcher identify and extract as wide a range as possible of [potentially] relevant publications from their own discipline (Occupational Health & Safety Management) and from other research relevant disciplines (e.g. Human Resource Management, Strategy and Strategic Management Practice). In line with best practice (Short, 2009) a select number of academic databases were searched for research-relevant articles, including: Emerald Insight, Science Direct, Taylor & Francis Online; Wiley Online Library; and Google Scholar. Key search phrases were utilised throughout, for example: human and social capital; Human Factors; accident causation; safety culture; safety climate; safety strategy; strategic management practice; safety leadership; psychological forces; and Psychological Capital. Also included in the methodology was backward and forward reference searching from retrieved articles to identify additional research-linked literature. Articles selected were reviewed for relevance of content and to frame the constituent elements of the research data collection process. Overall, the critical literature review built upon and extended previous research activity conducted by the researcher (Spence, 2013).

The critical literature review came to reflect an adaptive and evolving process. In some respects, aligning with the Foster et al. (2019) research where it was concluded that adaption in complex organisations is related to safety performance; in this case, research performance. Not unsurprisingly, the researchers' thoughts evolved organically from the initial study concept with subsequent realisation that the following nine items of empirical and theoretical research provided critical context to the overall research exercise. They served to illustrate that in order to improve safety performance in the UK Offshore Oil & Gas Industry, to avoid having accidents for '*old'* reasons,

consideration of factors beyond the still-predominant engineering and technical focus are required.

- Human capital was considered by Shultz (1993) as the key to unlocking economic growth given that it invents new forms of physical capital.

- Thomas and Ramaswamy (1996) in a study focused on matching Managers to Strategy through tests of the Miles and Snow [1978] typology, demonstrated organisations achieving an alignment between managerial characteristics and strategic direction perform better than firms where such an alignment is absent.

- Rochlin (1999) concluded that safety is more than simply the management of risk; the pursuit of safety is more than just the hunt for error and its elimination. A broad range of social constructionist approaches is required to advance understanding of how technically complex organisations achieve positive safety outcomes in the face of workplace and associated environmental challenges.

- Zohar (2008) acknowledges safety climate as a predictor of safety performance and highlights that the values-based explanation of culture (as proffered by Schein, 1992) embraces the core values and beliefs of senior managers where safety must originate as a priority. These core values and beliefs are therefore the antecedents of workplace policies, practices, and procedures that through implementation give rise to workers' [safety] climate perceptions.

- Kapp (2012) demonstrated that managers and supervisors (leaders) who are perceived to place a high value on safety achieve greater levels of safety compliance from their workforce than those leaders who are perceived to place a lower value on safety.

- Blazsin and Guldenmund (2015) consider that social constructionism appears particularly adequate to analyse culture in any of its manifestations. In the case of the current research, safety culture and its subsequent performance outcomes.

- According to Stowers et al. (2017) safety can be described by performance (i.e. safe and successful completion of tasks) and efficiency (i.e. timeliness and budget) in the working environment.

- Vukadinovic et al. (2018) concluded that having a proactive approach to managing human resource is a critically important element of business strategy.

- The development of Psychological Capital (PsyCap) has been recognised by Stratman and Youssef-Morgan (2019) as having the propensity to reduce unsafe behaviours in a workforce leading to an increase in safety performance.

Driven by the six general focus research questions generated from the research aim, the following eight sections document the primary areas of literature review relevant to the research. Ultimately, the goal of the research was to contribute to a reduction of accidents in the UK Offshore Oil & Gas Industry by, to avoid having accidents for '*old*' reasons. Therefore, the first subject matter considered through critical literature review was accident causation. The chapter concludes with a synthesis of the literature reviewed plus a chapter summary.

2.2 ACCIDENT CAUSATION

Within the UK Offshore Oil & Gas Industry, safety barriers [synonymous with the term *defence in depth*] are part of safety management doctrine. Safety barriers can be described as a safety function accomplished through operational, organisational, and technical constituent elements (Reason, 1997). Operational and technical barrier elements are readily definable however organisational influences, e.g. social interaction and related barrier elements may be more ambiguous (Storseth et al., 2014). This is somewhat ironic given the fact that many significant connections have been made in academic literature between safety performance and organisational factors (e.g. Reason, 1997; Dekker, 2012; and Hopkins, 2012). Looking at safety management beyond the UK Offshore Oil & Gas Industry, theories on accident causation plus the modelling of accident mechanisms proliferate in safety

science literature. The early theories e.g. Heinrich (1931) illustrate accident causation to be a one-dimensional sequence of [cause and effect] events. With accident and accident causation persisting as important themes within safety science; advancing safety through a reduction in accidents and incidents endures as a significant challenge to safety scientists (Salmon et al., 2012; Dekker and Pitzer, 2016). Commensurately, accidents and accident causation prevail as key themes within global Human Factors (HF) research endeavours (Salmon et al., *ibid*).

Traditional cause-effect accident models imply that complex system accidents are the direct result of key events such as catastrophic equipment failure or unsafe human action. This can result in equipment or people being incorrectly blamed for an accident. Regrettably, this approach most likely leads to missed opportunities to learn valuable lessons about safety system failures and reduces the likelihood of future accident prevention (Underwood and Waterson, 2013). Such an approach can never fully decode the complexity of an accident or the system it occurred in (Dekker, 2011). There is now broad acceptance that accidents are a feature of complex sociotechnical systems where causal factors exist and interact at all levels. With over half a century-plus of progress in safety science, sociotechnical systems theory and human factors methodologies accident causation models and analysis methods underpinned by systems thinking have emerged as the most prominent (Grant et al., 2018).

2.2.1 Seminal Early Research

Heinrich's 1931 publication *Industrial accident prevention: A scientific approach* is considered seminal research, still frequently referenced, and taught today. One of the most recognisable outputs from his body of work is the "*accident pyramid*" best known as the 'safety triangle' and depicted in Figure 2.1. The accident pyramid was developed from the analysis of accident data collected by a large insurance company [Heinrich's employer] over a period spanning more than thirty years. It focused on identifying causal factors of workplace accidents including "*unsafe acts of people*" and "*unsafe mechanical or physical conditions*". The work highlighted the associated costs of accidents and encouraged employers to consider investing in occupational

accident prevention, i.e. prevent or interrupt the sequence of accidents. The research posited the ratio between fatal accidents, accidents, injuries, and minor incidents to be 1-10-30-600. The ratio has become known as 'Heinrich's Law'. The second most recognisable output from his body of research is the domino model of accident causation (Heinrich, 1941), also known as the domino theory. This model implies a linear one-by-one progression of events resulting in an accident.

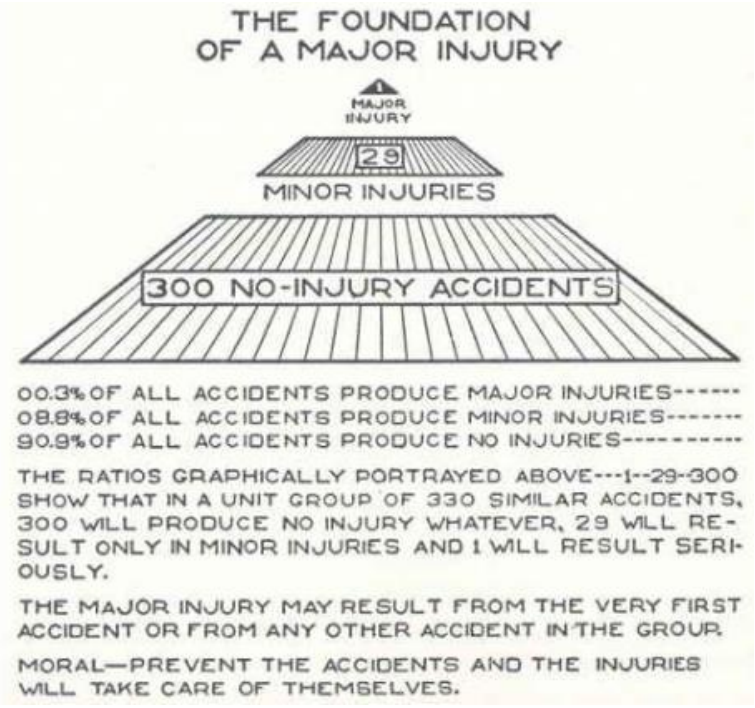

Figure 2.1 The "*accident pyramid*" (Heinrich, 1931)

Heinrich's research was pursued further by Bird during the 1970's, also an insurance company worker, who analysed more than 1.7 million accidents reported by 297 cooperating companies. These companies represented 21 different industrial groups, employing 1.7 million employees who worked over 3 billion hours during the study period. This subsequent research concluded that Heinrich's Law is relatively constant over time and across companies. Bird (1974) also proposed an update to Heinrich's domino model, with a further update two years later (Bird and Loftus, 1976). Heinrich's original model, Bird's 1974 update and the Bird and Loftus's 1976 revision update all explain accident causation as a one-dimensional sequence of events.

More recent research suggests that the ratios of Heinrich's Law may be misleading when considering the relationship between big and the small

consequence accidents; fatal versus non-fatal occupational accidents being one subset and major and occupational accidents being another. In some cases, bigger and smaller severity consequence accidents are thought to be related because of models like Bird and Germain (1985) in which unsafe acts and unsafe conditions are considered symptomatic of larger problems. In others, however, they are thought to be unrelated. Baker et al. (2007) in the report of the Texas City refinery explosion concluded with criticism the use of occupational injury statistics to measure process safety performance. Five years previously, Hale (2003) concluded that thinking the prevention of minor accidents leads to the prevention of major accidents is based on careless and unsupported reasoning. Hale's research (*ibid*) highlighted a need to take a scenario specific approach to understanding accident causation. In a similar vein, Dekker (2014: 124) makes a direct plea to readers considering human error as a topic to "*Please stop using the triangle*" on the basis that the mechanistic rationality of fixed ratio's is harmful to considered thinking about actual and future safety performance. Hopkins (2012) by reference to the Macondo Deepwater Horizon disaster sums it up clearly. The day before the accident senior company managers were offshore on the asset celebrating six years of injury free safety performance and covering the topic of falls from height very thoroughly. The celebration and safety topic conversation did not cause the explosion however, it was the senior managers skipping straight past the critical process safety issues about pressure readings with an '*everything okay'* question that begged a '*yes boss'* type of response. Dekker (*ibid*) considered six years injury-free performance should have delivered 3,600 years of accident performance in accordance with the Heinrich's triangle logic.

2.2.2 More Recent Research

Moving beyond one-dimensional cause and effect accident causation modelling, Reason (1990) introduced multi-causality of accidents into the safety science debate. Reason considers that accident causation is the result of an interaction between latent and active failures existing within an organisation. Active failures are the immediately observable causes of an accident; by contrast latent failures (e.g. deficient design, lack of competence and inadequate supervision) may have been present an organisations system

for a considerable time, perhaps years. Critically, and to circumvent active and latent failure interaction, pro-active engagement from top management was identified to be critical.

Uncovering causal factors leading to accidents has remained an active and principal topic within current safety research activity. From a broad range of studies (for example Reason, 1990; Rasmussen, 1997; and Underwood and Waterson, 2013) it is generally accepted that the occurrence of accidents reflects a complex systems-phenomenon where potential exists for causal [contributing] factors being present and interacting across all levels of socio-technical systems. An academic debate on accident models persists; new models created with simultaneous criticism and attempts to discredit older ones (Underwood and Waterson, 2013). Salmon et al. (2012) conclude that three accident causation models continue to dominate HF literature and academic debate: the Swiss Cheese Model (SCM) (Reason, 1990); risk management framework (Rasmussen, 1997); and Systems Theoretic Accident Modelling and Process Model (STAMP) (Leveson, 2004). All three models are underpinned by a systems approach, however there are compelling differences in theoretical grounding, adopted methodology, and outputs produced. Salmon et al. (*ibid*) consider that the selection of any one method over the other is likely to be driven by theoretical preference rather than any other consideration.

Within the UK Oil and Gas industry, James Reason's Swiss Cheese Model (SCM) is the common point of reference (Figure 2.2). The model was originally presented during 1990 and has undergone several revisions since (Reason, 2008). The SCM is a sequential loss causation model because it is based on the principle that there are successive safety barriers (figurative 'cheese' slices) that, when they fail, provide a hole through to the next barrier. If all the barriers fail, then all the 'cheese' holes line up, providing a path for an accident to occur. The concept of the model is such that a loss is never the causal responsibility of a single person or event, rather it relates to the incremental and accumulating failures in the chain of decisions and events leading to an accident. There needs to be a convergence of events and conditions (i.e. lining up of the holes in the various barriers) that permit accidents to occur. Within the oil and gas industry, this safety barrier

approach has become part of the orthodoxy in safety science and management. The Swiss Cheese Model rationale can describe, and be applied, to both occupational and MAH's within an organisation. The model recognises that an accident can only be caused by the simultaneous failure across all barriers. The SCM has been criticised by several researchers (e.g. Dekker, 2006, Hollnagel, 2012, and Leveson, 2012) who consider that the sequential nature of the model serves to oversimplify accident causation by not sufficiently accounting for the complex interactions across socio-technical systems. By implication, such criticism denigrates the SCM as no longer being capable of providing an applicable description of accident causation. However, Underwood and Waterson (2013) concluded that the SCM "*remains a viable model for understanding* accidents".

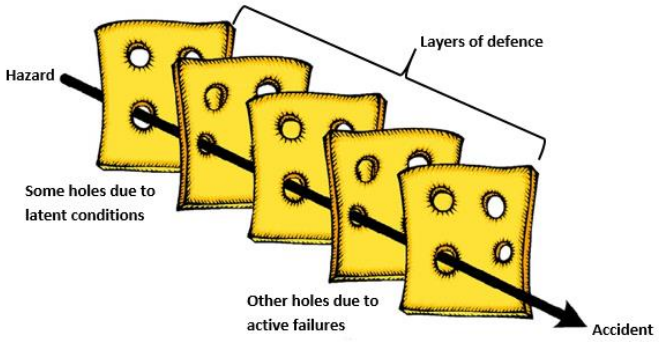

Figure 2.2 Swiss Cheese Model, adapted from Reason (2008)

The Human Factors Analysis and Classification System (HFACS) (Wiegmann and Shappell, 2003) is a taxonomy-based accident analysis approach inspired by Reason's Swiss Cheese model. The impetus for HFACS came from the absence of taxonomies of latent failures and unsafe acts within Reason's Swiss Cheese model, which according to Wiegmann and Shappell (*ibid*) limited its utility as an aviation accident analysis method. HFACS was subsequently developed based on an analysis of aviation accident reports and provides analysts with taxonomies of failure modes across the following four levels: unsafe acts; pre-conditions for unsafe acts; unsafe supervision; and organisational influences. The structure of the HFACS method is presented in Figure 2.3, and shows the different categories mapped onto Reason's model. Working backward from the immediate causal factors, analysts classify the errors and associated causal factors involved using the taxonomies presented. Whilst the HFACS framework was originally developed and applied

successfully in the analysis of aviation accidents, other industries have also successfully used the original framework, or a modified version, in accidents analysis, for example the maritime and railway industries plus medical organisations. More recently Theophilus et al. (2017) researched and proposed an HFACS framework specifically for the oil and gas industry.

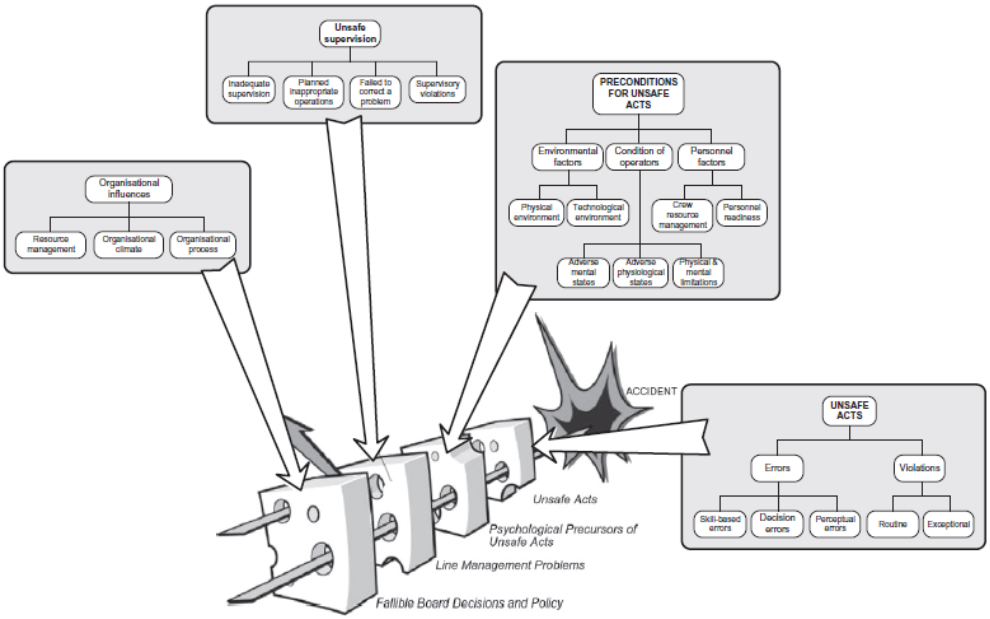

Figure 2.3 HFACS taxonomies overlaid on Reason's Swiss Cheese model from Salmon et al (2012)

Returning to the base-SCM concept (Reason, 1990 and 2008), it was utilised it as the cornerstone of the analysis of 'Human and Organisational Causes of the Gulf of Mexico Blowout' (Hopkins, 2012). The rationale for using the SCM was that, as well as acknowledging and depicting the complex nature of major accidents, it facilitated the consideration of each [and every] barrier failure without leading to an assumption that one barrier failure alone is the single cause. Storseth et al. (2014) subsequently conducted a re-analysis of the Hopkins 2012 study, placing significant and specific emphasis on the organisational barrier element of the in-place safety defences. Psychological forces, an integral part of HF, were concluded as direct contributors to risk transfer across established barriers and safety defences. The Storseth et al. (*ibid*) research provided significant impetus for the doctoral research undertaken and documented within the thesis.

2.3 HUMAN FACTORS IN THE WORKPLACE

The role of Human Factors (HF) in safety within the UK offshore oil and gas industry has been a source of primary interest since Lord Cullen's 1990 Inquiry into the Piper Alpha disaster. Based on the evidence available at the time, the immediate cause of the incident was judged to have been the ignition of a leakage of gas condensate resulting from the pressurization of pipework that was undergoing maintenance. This resulted in a series of explosions and fires leading ultimately to the structural collapse of the platform and the loss of 167 lives. However, during the Inquiry, Lord Cullen uncovered a litany of organisational and management failures perpetuated by the platform Operating company that indirectly contributed to the accident. These had significant HF implications and included inadequate training, non-adherence to safety procedures and the Permit to Work (PTW) systems poor communication, inadequate procedures and arrangements for securing evacuation and escape, plus evidence of a culture that appeared to emphasise the importance of production over and above safety.

HF is an extremely broad and multi-faceted topic. At a macro-level HF is concerned with all those factors that influence people and their behaviour in safety-critical situations at work. In the UK, the Health and Safety Executive in their 'Reducing error and influencing behaviour' publication consider HF as the working environment elements that influence behaviour at work in a manner that can affect health and safety outcomes: organisational factors; job factors; plus human and individual factors (HSE, 1999b). Kariuki and Lowe (2007) consider HF to be factors of environment, organisation, job, human and individual characteristics which influence behaviour at work with resultant health and safety affects. Cai et al. (2013) document that HF were identified to be clear contributors to the Deepwater Horizon disaster during 2010. When considering marine and offshore accidents over 70% have HF as contributing causes with only 30% attributed to technical failures (Cai et al., *ibid*). In a similar vein, Christou and Konstantinidou (2012) denoted bad safety culture of the Operator and its main contractors as the underlying cause of the Deepwater Horizon disaster. Fundamentally, HF influence human failures; they are a cause, with human failure being the resultant effect (Pranesh et al., 2017).

HF are traditionally seen to be significant contributors to workplace accidents and incidents. According to the HSE (*ibid: 6*) up to 80% of accidents may be attributed to the "*actions or omissions*" of people in the workplace. In dynamic complex systems such as aviation, nuclear, Oil and Gas the human contribution has been recognized as a root factor in 80–90% of accidents and incidents (Reason, 1990; Wiegmann and Shappell, 2003). Taking a different perspective, some researchers consider that human ability to adjust performance due to changing circumstances is a critical element of success (Hollnagel et al., 2006). Realistically, the human contribution in complex socio-technical systems is high; there are ever increasing technology demands requiring attention (Kirwan, 2001) with increased complexity creating greater propensity for error. Some research, however, concludes human error to be an unwanted side effect of workforces trying to succeed in imperfect, unstable environments with less than desirable or necessary resources (Dekker, 2002; Hollnagel et al., 2006). In such research human error is considered the consequence outcome rather than the antecedent.

The prevalent [negative] view on propensity for human error has unfortunately driven a short-sightedness within safety performance improvement endeavours, combined with a tendency to blame the individual(s) directly involved in tasks resulting in accident or incident. The rather one-sided perspective has frequently led to conclusions for the human element to be substituted by a [presumed to be] more predictable and reliable engineered solution. This approach ignores the deep and fundamental failures leading to accident or incident which are commonly located deeper in organisational design, management, and decision-making processes. Woods and Dekker (2000) consider the idea that new technology can be introduced as a simple substitution of machines for people thereby preserving the system though improving the results to be a gross over-simplification and therefore fundamentally flawed.

The research field of HF is vast as it "*studies the intersection between people, technology and work, with the major aim to find areas where design and working conditions produce human error*" (Woods and Dekker, 2000: 272). Re-visiting early literature and research on accident investigation practice, human error was the primary focus as opposed to the conditions and factors

that produced it. The definition of one single human factor, as well as its importance has varied over the years. Heinrich (1931) advocated analytic focus on 'man failure' and factors immediately exposed by incidents and accidents. The idea of faulty persons continued to influence work on accident prevention. It remained in literature from the late 50s. (e.g. Heinrich, 1959). Of note, the original study by Heinrich described causes of a 'supervisory nature' to account for 88% of all accidents in that study. The formulation which was later changed into 'unsafe acts of person' (Heinrich, 1959). It is unclear whether the change meant that accidents were attributed to the operator closer to the accident event instead of the supervisor, or that 'supervisory nature' had been generalised into a broader category 'human error'.

The old Heinrich (1931, 1959) categorisation included a set of labels (e.g. ignorance of regulations, recklessness, nervousness, and excitability), which were not utilised in later works. More recent literature on safety has kept the principle 'ignorance of regulation' through use of the labels such as 'error' and 'violations'. An error is unintentional, while violations are intentional. Errors were further classified into skill-based errors (which included things such as slips of action or lapses in memory) and mistakes (which could be rule based or knowledge based); while violations could be routine, situational, or exceptional. (Reason, 1990). Slips occur when an action does not go as planned, and they are potentially observable, e.g. slips of performance or slips of the tongue. Lapses represent a more covert form of error forms, largely involving failures of memory but which do not manifest in actual behaviour or accidents; hence they may only be apparent to people who experience them. Mistakes include deficiencies in the process of making judgements or inferences, where people take the wrong action but believe it to be correct and appropriate. They are more complex and less well understood than slips; for that reason, they constitute a greater degree of danger in a Major Accident Hazard (MAH) industry environment such as Offshore Oil & Gas and are much harder to detect. Mistakes can arise at a rules-level or a knowledge-level. Rule-based mistakes occur when an individual's action is based on remembered rules and procedures, typically in familiar circumstances while knowledge-based mistakes result from misdiagnosis and miscalculations when dealing with unfamiliar

circumstances. Violations represent a further and different type of human error; they are deliberate and intentional acts which breach regulations, policies, directions, instruction, or commonly accepted ways of working. Violations may be routine, situational, or exceptional. The intention of a violation may not be to deliberately cause harm (sabotage) rather to gain time or simply to make a job easier by taking a short cut.

Thus, and despite recent interdisciplinary research on more peripheral factors, it seems that the idea of (individual) human erroneous acts (tracing back to Heinrich) nevertheless persist in research. Similar to Heinrich's conclusions and statistics (Heinrich, 1931, 1959) concerning so called moral and supervisory failure, studies (for example Wagenaar and Groenweg, 1987; Cook and Woods, 1994; plus Schappell and Wiegmann, 2000;) repeatedly show that approximately 70–80% of human errors may be attributed to individuals or to human cognition. It is to be observed, however, that analytic categories and taxonomies in research on human errors do not agree but rather complement one another. Where an accident starts, which factors it involves and how individual actors are analysed in relation to this is thus something that is under constant re-construction (for example Rasmussen, 1982; O'Hare, 2000; and Lundberg et al., 2009r) as is the use of the concept of human factor. Also, some additional theories view undesired events as something normal and expected. Typified by Hollnagel (1993) who does not speak of human error, rather function and performance variability where different sorts of deviations may be expected. A trend in more modern research is to turn away from the search for single bad individuals, so called ''bad apples". Attention moves from what in hindsight obviously was wrong to explaining why those actions made sense at the time (Dekker, 2002). This has moved attention from issues near the operator (the sharp end) to factors that have shaped the conditions for work, such as management decisions (the blunt end). At the same time taxonomies of causes have broadened to, for example, general human cognitive properties, environments, organizations, technologies, infrastructures, and preparedness. Consequently, more recent safety research is closer to the definition of the area of human factors cited above (Woods and Dekker, 2000) than to early research.

In the UK Offshore Oil & Gas Industry attention remains focused on fostering safety strategies such as *'defence-in-depth'*, with a focus on barriers that prevent accidents from happening but with HF taken strongly into consideration. Figure 2.4 depicts the Step Change in Safety (2017) Human Factors and barrier model, building on the Reason (1990) Swiss Cheese model by acknowledging that established safety barrier defences may be influenced by a range of HF.

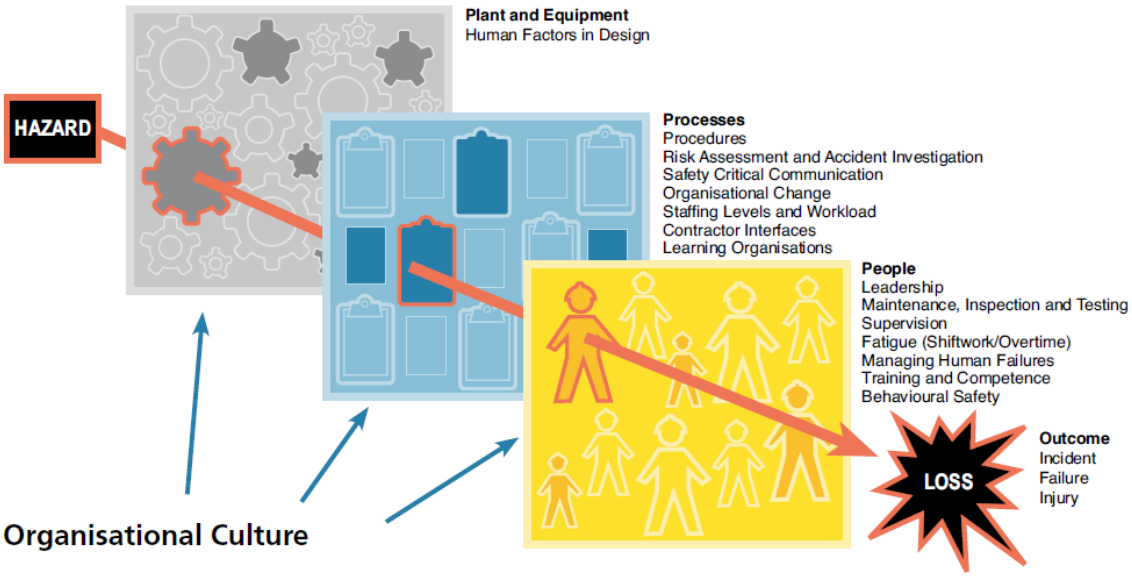

Figure 2.4 Step Change in Safety (2017) Human Factors and the barrier model

The principle applied in the model is that through failure to account for Human Factors, gaps may open-up in one or more of the barriers, permitting energy transfer through the barriers and thereby increasing the chances of an accident event. The model does not, however, directly acknowledge the psychological forces dynamic and propensity for risk transfer across established safety barriers (Storseth et al., 2014) but it does acknowledge the important influence of organisational and safety culture. Finally, Vogt et al. (2010) considered that a balanced scorecard approach to Human Factors within safety strategy would provide a means of identifying enablers of safety plus a means of systematically allocating resources to them. It becomes clear therefore, that effective management of HF within overall business and safety strategy may become capable of delivering business benefit through increased efficiency and prevention [plus reduction] of accidents and incidents (Vogt et al., *ibid*). As a strategic component, effective HF

management becomes capable of delivering competitive advantage to businesses engaged in the UK Offshore Oil & Gas Industry.

2.4 SAFETY INFLUENCING CAPITAL

2.4.1 Human Capital

Research literature highlights the importance of human capital to organisational competitiveness, innovativeness, improved performance, and economic success (Marimuthu et al., 2009; Unger et al., 2011; Diaz-Fernandez et al., 2014; Kottaridi et al., 2019;). An organisations' human resources were considered by Barney (1991) to be its greatest source of competitive advantage, consequently, the relationship between an organisation's strategy requires further examination particularly regarding safety performance. In a similar vein, Schultz (1993) considered human capital to be a key element of increasing productivity and sustaining competitive advantage. With specific regard to competitive advantage, Pasban and Nojedeh (2016) declared for an organisation to distinguish its products and services from those of competitors it must employ more talented and skilled employees although this consideration overlooks the development of human capital from within the existing organisational [human] resource pool. Rastogi (2000) considered the concept of human capital to include but advance beyond the conventional concept of human resources. Rastogi (*ibid*) reflected that although training and development of employee's skills, motivation, and involvement of employees in decision making are common, the essential focus of human capital is to ensure that the competitiveness of an organisation is sustained. To be value-adding in nature, human capital itself requires to be continually developed as a reflection of an organisations changing environment; adaption is required to consistently convey [internal and external] customer-valued deliverables. Furthermore, the focus on human capital as a source of competitive advantage has also led to a tighter coalescence between the research fields of strategic management and strategic human resource management to unlock the perceived competitive advantage of human capital (Shaw et al., 2013).

At a macro-level, accidents and incidents deteriorate human capital and detrimentally affect the productivity and competitiveness of nations (Fernandez-Muniz et al., 2009). At a micro-level, the same conclusion may be drawn for industry sectors and individual organisations. The common denominator being significant human cost, loss of economic potential and decreased productivity, starkly illustrated by two previously mentioned Oil and Gas industry examples. Firstly, the fire and explosions on Piper Alpha 6th July 1988 led to 167 fatalities, complete loss of the production facility and remains the deadliest accident in the history of the offshore Oil and Gas Industry; it affected 10% of the UK's oil production at the time and resulted in financial losses of an estimated £2 billion (IChemE, 2018). Secondly, the Gulf of Mexico Deepwater Horizon well blow-out 20th April 2010. In addition to 11 fatalities and complete loss of the drilling asset, it spilled 4-million barrels of crude oil into the Gulf of Mexico, disrupted a regional economy and damaged fisheries and critical environmental habitats (Christou and Konstantinidou (2012). Considering these two illustrations of the [potentially significant] effect from accidents and incidents, it becomes apparent that an organisations' performance may be viewed in financial or non-financial terms with safety performance being a component of the latter. Marimuthu et al. (2009) concluded that financial performance is positively impacted through consideration of human capital and additionally paves the way for improved achievement through creativity and innovation. From a resource-based perspective human capital study Shaw et al. (2013) demonstrated that investment in human capital had a moderating effect on organisational accident rates. The study results give credence to the discourse where, instead of being an economic burden on organisations, focusing on accident reduction through the human element provides business opportunity since it has the potential to deliver a positive effect [competitive advantage] on organisational performance. Consequently, there is propensity to lessen the deterioration of human capital while positively affecting productivity and competitiveness. Luthans and Youssef (2004) identified that Human Capital may be managed to generate sustainable improvement contributing to an increase in competitive advantage. Techniques identified in the research included: processes to address selection and selectivity; training and development activities; and building tacit knowledge through increased competence and awareness, even by relatively simple job rotation.

2.4.2 Social Capital

Rastogi (2000) purports social capital to be the base of human capital. Although papers have been written which seek to clarify the concept (Lin, 1999; Paldam, 2000; Adler and Kwon, 2002; Durlauf, 2002; and Sobel, 2002). Adler and Kwon (*ibid*) conclude that several definitions remain rather than one single accepted definition. Ostrom (2000: 176) defines social capital as the shared knowledge, understandings, norms, rules, and expectations about patterns of interactions that groups of individuals bring to a recurrent activity. Putnam (2000) considers social capital to be the connections between individuals, social networks in addition to the norms of reciprocity and trustworthiness that subsequently arise. Rastogi (*ibid*: 199) defines social capital as "*a shared vision and a shared value system, and an ethos of help and care unimagined resource capabilities for wealth creation and excitement emerge in an organization*". From the range of definitions, and for the purpose of research, it was determined that social interaction in the workplace is central to the ongoing development of social capital, in turn human capital. It occurs within the framework provided by an organisations' structures, systems, and processes. To be positive in nature it requires trust and cooperation, plus a clear unity of purpose. Over time, interactions will develop and mature with the resultant continually developing social capital influencing human capital growth such that people (individually and collectively) are able to direct their efforts (creativity, energy, intelligence, and competencies) into value-adding activities: i.e. delivering competitive advantage, including positive safety performance. More recently, occupational health and safety has become considered to be an essential element of human capital (EHS Today, 2017) with corporate reporting of human capital metrics demonstrating improved corporate performance and risk mitigation. In this way the effective management and deployment of human capital for value creation is becoming increasingly important to actual [and potential] investors, reflecting further competitive advantage.

The relationship between social and human capital resonates for safety performance as a non-financial indicator of organisational performance. Previously identified in Chapter 1, the "*dynamics of social interaction*" have clear potential to generate safety barrier defeating forces (Storseth et al.,

2014: 54) when acted upon may subsequently result in accident and incident. The indicative interpretation being that trust, cooperation, and unity of purpose within social interaction have been substantially undermined. Storseth et al. (*ibid)* suggest that consensus-mode decision making, confirmation bias and groupthink are among the significant psychological mechanisms capable of detrimentally impacting social interaction processes. Human psychology thus became a causal element of the Gulf of Mexico Deepwater Horizon disaster along with both organisational and technical failings. For current research, this latter deduction reflected the position where human and social capital aspects conveyed into Human Factor considerations for safety performance, accident and incidents within the UK Oil and Gas Industry.

As in the case with Human Capital, Luthans and Youssef (2004) identified that Social Capital may be managed also to generate sustainable improvement contributing to an increase in competitive advantage. Techniques identified in the research include creating and maintaining open communication channels; developing cross-functional teams; and building sustainable work-life balance programs.

2.4.3 Psychological Capital

The Oil and Gas Industry's high propensity for accidents, both major and occupational health, drives organisations working in the value chain to be classified as safety critical organisations (SCO's). Ergo, initiatives to reduce accidents, near misses and to continually improve safety performance outcomes are a primary concern for such organisations. Protection from harm, irrespective of what model is followed (e.g. SCM) relies on the consistent and effective implementation of policies, practices, and procedures by personnel in the workforce. The Researchers practical experience plus published formal accident enquiry reports (e.g. Bohai 2, China 1979 – 72 fatalities; Alexander L Kielland, Norway 1980 – 123 fatalities; Piper Alpha, UK 1988 - 167 fatalities; Mumbai High North, Indian Ocean 2005 – 22 fatalities; and the Usumacinta Jack-up, Gulf of Mexico 2007 – 22 fatalities) inform that personnel, both individually and collectively, are not always compliant and that deviations still occur. Henning et al. (2009) consider this lack of

compliance due to factors such as employee attitudes, individual risk propensity and organisational [safety] climate. Havold (2007) considered factors influencing positive safety behaviour within the workforce to be individuals' satisfaction with safety activities plus management attitudes towards safety. Hence it is essential for SCO's working in the Oil and Gas Industry to identify factors that can improve the implementation and effectiveness of planned safety arrangements (i.e. pre-identified safety defences).

Over at least the past four decades Researchers have been seeking to identify various characteristics that affect people's performance in addition to that at the organisational level. A range of approaches have been pursued, from the industrial organisation view of the 1980's (Porter, 1998) to the resource-based view (RBV) of organisations developed in the 1990s (Barney, 1991; Wernerfelt, 1984). Through the progress of time organisations have had to adapt, for example, to technological changes, market movements, an evolving competitive landscape, political instability and regulatory (local and international) changes to remain competitive. Unsurprisingly, other performance affecting significant elements (e.g. human capital, leadership, and organisational culture – all considered in the current research) have come under scrutiny (Aras and Crowther, 2010; and Dahlgaard et al., 2013). Regrettably, many organisations fail to maximise their performance and competitive potential and from a safety perspective, disasters still occur e.g. the Deepwater Horizon explosion in the Gulf of Mexico during April 2010, where there were 11 fatalities and an environmental catastrophe with a total cost estimated to exceed $65 billion US dollars (Offshore Technology, 2019) Gulf of Mexico disaster. Clearly there is a difference in understanding between the relevance and importance of theory versus its enactment to stimulate organisational performance improvement and hone competitive edge. One of the main reasons to be considered for the deficit is shallow knowledge about, and deficient understanding of humans, both individually and collectively in groups.

Psychological capital is a form of positive organisational behaviour with the capacity to develop and manage personal strengths. Luthans (2002: 59) defines positive organisational behaviour as "*the study and application of*

positively orientated human resource strengths and psychological capacities that can be measured, developed, and effectively managed for performance improvement". Reichard, et al. (2011) and Avey (2014) consider that PsyCap is consistently, positively, and significantly related to employee performance. This is particularly relevant within the Oil and Gas Industry where individuals must frequently adapt to rapid and unpredictable situations in their hazardous working environment. Thus, positive organisational behaviour may be considered an important attribute leading to safe operation and continual improvement of safety performance outcomes. From Luthans et a. (2007) four psychological constructs constitute psychological capital: Hope; Efficacy; Resilience; and Optimism (HERO). They represent an individual's positive psychological state of development. When combined with appropriate leadership interaction PsyCap may promote greater safety awareness and improve safety performance, both at the individual and group level. Each of the four constructs are considered individually.

The word Hope is commonly used in everyday language but as a concept it refers to an individuals' ability to persevere towards goals and, as necessary, modify the steps to goal attainment and success. Hope was defined by Snyder et al. (1991) to be a positive motivational state generated through the combination of goal-directed energy (agency) and the ability to plan for goal achievement (*pathways*). Expressed another way, hope is constructed from both willpower and waypower thinking (Avey et al., 2009) where willpower is an individual's expectancy and motivation for attaining a desired goal with psychological resources (pathways) assisting with alternative routes to goal attainment. It is the alternative pathways thinking that assists individuals to achieve goals despite the presence of impediments. As such, individuals with greater levels of hope can conceive many strategies for goal attainment and, importantly, develop alternates when success is not achieved at the first attempt. Also, success breeds confidence for future activity in hopeful individuals (Snyder, 2000). For an individual with low levels of hope, the pathway to goal attainment will not be well thought through and alternate plans difficult to establish in the event of initial failure. Consequently, individuals with low levels of hope have greater propensity to disengage from goal attainment, with the associated negative emotions adversely affecting future goal setting and pursuit. From a safety performance perspective, a

hopeful individual will seek out new opportunities and comfortably implement new safety measures and provisions when obstacles appear with the propensity to hinder originally laid plans and goal achievement. Such an individual is more likely to retain a positive focus on safety and is less likely to drift into an overconfident and/or complacent attitude towards safety.

Efficacy implies that individuals have the confidence take on and succeed when they confront complex and challenging tasks. As a concept, its origins lie within social cognitive theory (Bandura, 1997) and its link to workplace performance were established through Stajkovic and Luthans studies (1998). To develop efficacy in individuals, Bandura (*ibid*) defined four recognisable approaches: mastery or success experiences; vicarious learning or modelling the experiences of [relevant] other people; social persuasion and positive feedback; finally, physiological, and psychological arousal. A strong sense of efficacy enhances human accomplishment and personal well-being in many ways. People with high confidence in their capabilities consider difficult tasks as challenges to be accomplished rather than as threats to be avoided, fostering an intrinsic interest and deep engrossment in challenges. Such individuals set themselves challenging goals and maintain strong commitment to them throughout, heightening, and sustaining effort in the face of potential failure. In the event of failure or setback, individuals quickly recover their sense of efficacy, attributing the failure or setback to insufficient effort or deficient knowledge and skills which are ultimately attainable. Further, they approach *threatening* situations with confidence that they can exercise control over them (Bandura, 1994). From an Oil and Gas Industry perspective, individuals must feel confident they have the necessary skills and technical knowledge to perform their assigned tasks, have the necessary hazard and risk awareness for the working environment plus the confidence and empowerment to report potential hazards and problems (Eid et al., 2012). Clearly, the development of efficacy within individuals offers opportunities for developmental success and improved safety performance.

A resilient individual possesses the ability to sustain performance and importantly recover when beset by problems and hard times. Such an individual never gives up and will always strive to overcome difficulties. Luthans (2002: 702) defined resilience as "*the capacity to rebound or bounce*

back from adversity, conflict, failure or even positive events, progress and increased responsibility". Masten and Reed (2002) contend that resilience within individuals is characterised by patterns of positive adaption in the face of significant adversity or risk. The concept is considered to represent the application of positive patterns of adaption and psychological processes to overcome adversity, or risk factors, by leveraging personal, social, or psychological assets. When the outlook is bleak, such patterns of positive outlook result in individuals searching for opportunities to convert adversity and setback into opportunities for personal learning and development (Bonanno, 2004; Mancini and Bonanno, 2006). Resilience ultimately represents the difference between individuals who recover well from adversity and those who cannot or find it difficult to move on. Research (Avey et al., 2009) has disclosed that resilient individuals are better equipped to deal with stressors in constantly changing work environments due to being: adaptive to changing demands; emotionally stable in the face of adversity; and more open to new experiences. Translating these attributes into an Oil and Gas Industry application, resilient individuals may be considered highly valued assets in the constantly evolving, unpredictable, challenging and frequently hazardous environment.

Optimism refers to an individuals' ability to make positive and realistic assignment about success, current and future. In a general sense, optimists expect good things to happen. It is a positive explanatory style that attributes positive events to personal, permanent, and pervasive causes. Conversely, negative events are attributed to external, temporary and situation specific factors (Carver and Scheier, 2002). The researchers postulate that when individuals possess positive expectancy, they will persist with positive efforts despite increasing adversity whereas pessimists, lacking positive expectation, are unable to initiate action leading to goal attainment. An alternative definition was proposed by Seligman (1998) where optimism is considered as an explanatory style where individuals *explain* to themselves why self-defined good or bad things happen to them. On this basis, optimists make internal, stable, and global causal attributions of positive outcomes; external, unstable, and specific attribution of negative events. Pessimists, conversely, attribute positive outcomes with external, temporary and situation specific attributes; negative outcomes attributed to personal, permanent, and

pervasive causes. Optimists therefore possess a positive psychological state that enables them to keep moving forward through retained motivation. To generate success, being solely optimistic is not sufficient. However, when combined with hope goal attainment may be broken down into practical steps towards achievement. As such, optimism has become associated with a range of positive performance outcomes, including job performance (Youssef and Luthans, 2007). Considering the Oil and Gas Industry perspective, possessing an optimistic tendency to see the possibility for [positively] changing situations is important for acting in accordance with safety plans, policies, and procedures; generating improvement; and taking action to avoid negative safety outcomes.

Avey (2014) acknowledged that from literature, there is not much evidence to prove the antecedents of PsyCap. Although many prior studies have focused on the ability of PsyCap in anticipating workplace attitudes and behaviours, Avey (*ibid*) considered there to be void concerning the antecedents of PsyCap. However, in a more recent study, Wu and Nguyen (2019) confirmed leadership to be an antecedent of PsyCap, particularly authentic and ethical leadership styles. Also, in terms of consequences (outcomes) of PsyCap the research results demonstrated that positive leadership such as authentic leadership positively related to desirable work attitudes such as organisational commitment. Overall, PsyCap is an evidence-based core construct and positive approach that managers [and safety practitioners] may leverage to tap into underutilised human strengths to deliver excellence in organisational performance. Emphasis on the criteria of being positive, measurable for validity, developmental, and related to desirable work outcomes has helped PsyCap to grow as an approach due to its retained scientific rigor and practical relevance. The solid foundation established during the past decade-and-a-half strengthens PsyCap, and positivity in general, as a valuable capital resource for individuals, teams, and organizations. Building a conceptual model of the affiliation between PsyCap and safety performance (Eid et al., 2012) contended that PsyCap may represent a more positive motivational state thereby promoting an increased level of safety behaviour and associated practice. In a study to examine the role of PsyCap in the perception of safety climate amongst Air Traffic controllers it was concluded that there were significant positive associations

between safety climate and PsyCap, highlighting the important role that PsyCap appears to fulfil in developing and sustaining safety climate (Bergheim et al., 2013). Furthermore, a recent maritime industry study (Bergheim et al., 2015) concluded that PsyCap would be a desirable and an interesting construct to include in future research on safety related matters, hence relevant to the current research.

Consistent with Human and Social Capital, Luthans and Youssef (2004) identified that PsyCap can be managed to generate sustainable improvement and contributing to an increase in competitive advantage. Managed improvement can be achieved through all the construct feature levels: self-efficacy (e.g. through vicarious learning, experience mastery and positive feedback), hope (e.g. goal setting and contingency planning); resiliency (e.g. through asset and risk-focused strategies); and optimism (e.g. through future opportunity identification).

2.5 CULTURE

Culture has been studied for many years by both anthropologists and sociologists producing extensive debate and numerous resultant definitions. There remains, however, no single agreement on what the concept means. More recently researchers have focused on the linkage between organizational culture and performance, recognising the importance of leadership in understanding, building, and sustaining aligned cultures through their strategic endeavours to deliver performance and competitive advantage (Mohelska and Sokolova, 2015; and Warrick, 2017). Considered to be a major factor in the success of any given organisation, culture has significant influence over key organisational aspects: performance and effectiveness; morale and productivity; plus, the ability to attract and retain talented people. Clearly culture has strong implications for the ongoing development of social capital, in turn human capital (Rastoggi, 2000). An extension of this debate, relevant to the current research, would be to consider how organisational culture might influence the development of a safety culture, and subsequently safety performance when vectored through the Human Factor.

2.5.1 Organisational Culture

The concept of organisational culture was the focus of significant attention and research during the 1970's and 1980's. As a concept it is complex and difficult to define (Guion, 1973; Glick, 1985; Schein, 1992; and Guldenmund, 2000). There are many ways to define organisational culture given it is influenced by numerous factors, for example the sector in which the organisation operates, its geographic location, the events that occurred during its history, personalities of its employees, and their patterns of interaction. The diversity of these concepts being both global and abstract have the propensity to be virtually meaningless and of little benefit to the current research. In the seminal research paper '*The nature of safety culture'* Guldenmund, (*ibid*) concludes that organisational culture is a shared construct: somewhat stable; multidimensional in nature; that provides a frame of reference giving meaning to (or is reflected) in organisational practices. Seven key characteristics of organisational culture were deduced through Guldenmund's research which also importantly identified differences between the concepts of safety culture and safety climate.

Edgar Schein, a celebrated and leading authority of organisational culture studies deliberately uses the word *group* to describe social units of all sizes. The recognition being that the term group could refer to a complete organisation or a small group of individuals that, regardless of size, are likely to form a specific culture (Schein, 1992). Complimentary to Schein's perspective a further elementary description to focus upon is that culture represents the unspoken, and usually invisible sets of beliefs and assumptions shared by individuals in an organisation (Hudson et al., 2002). This definition reflects in practical terms organisational culture describes the environment in which people work and the influence it has on how they think, act and experience work. Not unexpectedly, cultures may differ significantly between and within organisations. This may bring out the best in people and create effective and productive working environments; alternatively, it may bring out the worst in people where dysfunctional environments of stress and tension become created. Of relevance and recalling Chapter 1, it was identified that the "dynamics of social interaction" have clear potential to generate safety barrier defeating forces (Storseth et al., 2014:54) which

when acted upon may subsequently result in accident and incident. Continuing to write extensively on organisational culture and leadership, Schein (2017) declared a dynamic definition of culture that, importantly, takes into consideration organisational experiences of external adaption and internal integration. It reflects the constant evolution of culture:

"The culture of a group can be defined as the accumulated shared learning of that group as it solves its problems of external adaption and internal integration: which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, feel and behave in relation to those problems. This accumulated learning is a pattern or system of beliefs, values, and behavioural norms that come to be taken for granted as basic assumptions and eventually drop out of awareness."

Schein (*ibid*) through this definition has concluded the most value-adding means of arriving at a meaningful definition of something as abstract as culture is to consider it from a dynamic perspective, acknowledging what groups have learned through strident efforts to: survive; grow; adapt to the external environment; and become efficiently organised internally. This definition resonates for the current research given its alignment with the Miles and Snow (1978) typology – organization strategy, structure, and process (the adaptive cycle) addressed in Literature Review section 2.8.2.

Clearly, many factors have the propensity to influence the development of organisational culture, the result reflecting each organisations' leaders. Steers and Shim (2013) concluded that leaders influence the development of culture through their developed strategies, implemented strategies, established values, style, and personally demonstrated behaviours; strong leaders delivering strong cultures. Following on from this, Warrick (2017) defined ten guidelines for building and sustaining culture. First and foremost is to make culture and strategy an important leadership priority, the belief being that when leaders are focused on both culture and strategy through their planning and decision-making processes strong alignment will be achieved. More effective performance and competitive advantage will be delivered plus cultural development will not be left to chance.

Considering competitive advantage through the lens of improved safety performance, it was noted previously in literature review that effective management of HF within overall business and safety strategy provides a capability to deliver business benefit through increased efficiency and prevention [plus reduction] of accidents and incidents (Vogt et al., 2010). With a clear focus towards safety performance, Reason (1997) considers Uttal's (1983) definition of organizational culture most closely capture the essence of organisational culture: "*shared values (what is important) and beliefs (how things work) that interact with a company's people, organizational structures and control systems to produce behavioral norms (the way we do things around here)*". Consideration for the concept of safety culture was therefore required within the current research. Although it has been used widely for an excess of three decades the concept of safety culture remains somewhat abstract and is at times a contentious notion (Le Coze, 2019).

2.5.2 Safety Culture

The roots of safety culture lie in the wider concept of organisational culture and have a relatively recent history (Schein, 1985; Meek, 1988; and Denison, 1995) in organizational psychology. Meek (*ibid*) noted that the culture concept was borrowed from the structural–functional paradigm of the anthropological tradition. The concept is characterised by complexity; in one respect it is challenging content-wise, and in another it may be considered a multi-dimensional and cross-disciplinary research domain. It is also not without contention among researchers and business users (van Nunen et al., 2018; Le Coze, *ibid*). Overall, safety culture as a concept appears to be derived from the tradition of organizational culture (Cox and Flin, 1998; Richter and Koch, 2004).

Many high reliability and safety critical industries around the world have developed an ever-increasing interest in the concept of 'Safety Culture' as a means of realistically lessening the potential for catastrophic events and disasters. Research has also concluded that organisations with good safety culture tend to have fewer accidents (Mearns et al., 2001; and Zohar, 2010). Linked to safety management systems (Corrigan et al., 2019) consider that

if there is no real commitment or culture towards safety then an organisations' established safety management system will have reduced effectiveness as part of overall business strategy since safety will not receive prioritisation in the decision-making process; therefore a threat to safety performance and a reduction in organisational competitiveness. In a recent bibliometric analysis of safety culture, i.e. a quantitative analysis of published information without a qualitative analysis of its content, van Nunen et al. (*ibid*) revealed 1789 publications relating to safety culture published between 1900 and 2015 through the Web of Science. The 1789 publications covered 4591 authors and 775 journals. The research indicated that safety culture has been a field of extensive research during the last ten years or so as defined by an exponential growth in research output. However, the data trends also indicated a saturation of scientific output in this field.

The term 'Safety Culture' was first used by the International Atomic Energy Agency (IAEA) through the International Safety Advisory Group (INSAG) Summary Report on the Post-Accident Review Meeting on 26th April 1986 Chernobyl nuclear accident (INSAG, 1986) and subsequently expanded upon during 1988. The INSAG proposed definition of safety culture was:

"Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

As originally conceived, safety culture had two general components: firstly, the necessary framework within an organization and is the responsibility of the management hierarchy; and secondly the attitude of staff at all levels in responding to, and benefiting from, the identified framework. Ultimately the purpose was to provide clarification and develop a commonly shared understanding of safety culture within the nuclear industry. It reflected a tangible commitment to safety at all levels within [nuclear industry] organisations with the intention that it should permeate all activities of the work environment.

During the intervening three-plus decades, safety culture has been a widely debated and researched subject and has made its way into the fabric of many high-risk industries (e.g. aviation, chemical, medical, nuclear and oil and gas) as a means of framing the issue of safety performance from an organisational perspective. Organisations operating in such industries are acknowledged to be complex sociotechnical systems. Taking an interpretive organisational theoretical stance, rather than the functionalist view of an organisation (plus its human capital) Reiman and Oedewald (2007) contend that complex sociotechnical systems are both socially constructed and dynamic in nature. Aligned with this purview Weeks and Galunic (2003) culture to be an emergent social phenomenon, created and shaped by agency and power: not by any official order or mandate. Further, Weeks and Galunic (*ibid*) acknowledge that for cultural evolution, some persons have more influence in an organisation than others, with organisational authority alone not sufficient to shape cultural development. For the current research, the dynamics of social interaction (Storseth et al., 2014) are interpreted to have a key role to play in cultural evolution where, for example, it becomes culturally acceptable to bypass formally established safety practice policies and procedures.

Unfortunately, the safety culture concept is frequently considered separately from the other characteristics of the organisation, such as the organising of work, technology, organisational structure, and business strategy. This leads to safety culture being considered independent of wider organisational culture; at best loosely connected (Reiman and Oedewald, 2004). As a result, the conceptual separation leads to safety culture being considered only in relation to factors that are clearly connected with safety, such as safety attitudes and safety values. This outcome is typified in the definition offered by Arezes and Miguel (2003: 23) where safety culture is described as "*the enduring value and priority placed on worker and public safety by everyone in every group at every level of an organization*". Here safety culture reflects the extent of commitment individuals and groups have in relation to personal responsibility for safety, safety preservation, safety enhancement and communication of safety concerns within their organisation. Overall, the definition results in the loss of the holistic perspective originally sought from the organisational culture concept (Guldenmund, 2000; Choudhry et al.,

2007). More encouragingly, however, recent research indicates increased inclusion of human aspects in the safety culture concept in addition to [acknowledged] technological aspects (van Nunen et al., 2018). This positive development is reflected in Reiman and Rollenhagen's (2014) perspective that safety culture represents a holistic, comprehensive term that comprises a totality of technological, organisational, and human factors.

Finally, van Nunen et al's (*ibid)* bibliometric analysis of safety culture research recorded that the most cited research paper is from Guldenmund (2000). This seminal research considered the nature of safety culture through a review of theory and research. Importantly it considered the concepts of both safety culture and safety climate, providing a means of differentiation. It was concluded that the assessment of safety culture may provide insight into attitudes leading to safety performance improvement and the avoidance of major accidents; measurement of safety climate might be utilised as an alternative safety performance indicator beyond the *traditional* recording of accident and incident events.

2.5.3 Safety Climate

During the past three decades the presence of a positive relationship between safety climate and the safety behaviour of persons working in high risk and safety critical organisations has been confirmed by an extensive number of research studies, including from within the Oil and Gas Industry (Griffin and Neal, 2000; Clarke, 2006; Clarke and Ward, 2006; Agnew, Flin and Mearns, 2013; and Dahl et al., 2014). Safety climate can be defined as the set of perceptions that employees share regarding safety in their work environment (Zohar 2010) and the body of research, in summary, demonstrates that individuals who perceive that safety is prioritised and valued within their organisation display more positive safety behaviours than those who perceive their organisation to place lower priority and value on safety.

According to Clarke (2006), the safety climate of an organisation acts as a frame of reference for safety-specific behaviour and attitudes of both individuals and groups of employees. Further, Zohar (2010) assumes that it is within this frame of reference that employees receive, interpret, and make

sense of signals from a complex web of sources (colleagues, policies, leadership, competing domains, etc.) about what sort of role behaviour is expected, supported, and rewarded. Employee behaviour will then tend to align with these perceived expectations. For current research Zohar's assumption is interpreted to align with the identified literature that complex sociotechnical systems are both socially constructed and dynamic in nature, with culture (reflected through safety culture) as an emergent social phenomenon, created and shaped by agency and power (Weeks and Galunic, 2003; plus Reiman and Oedewald, 2007).

Arezes and Miguel (*ibid*: 23) consider safety climate to include a "*temporal state measure of safety culture, subject to commonalities among individual perceptions of the organization*". When considering safety climate, it is important to be distinguished from safety culture within research (Flin et al., 2000; Guldenmund, 2000) where the former is a manifestation of the latter. Safety climate is therefore situationally based and refers to the perceived state of safety at a particular location and time. Potentially this makes safety climate relatively unstable and subject to changes influenced by the working environment or prevailing conditions. Amongst members of a social unit, safety climate may be defined as shared perception of policies, procedures and practices related to safety in the organisation (Zohar, 2000; and Griffin and Neal, 2002).

Mearns et al. (2001) consider safety climate to be an important element of organisational reliability. Zohar (2003 and 2010) concludes that 30 years of research has validated the use of safety climate as a robust leading indicator of safety performance. Further traction is provided by Bjerkan (2010) who acknowledges that it has become increasingly recognised within the oil and gas industry that safety culture and climate are of particular importance in securing the health and safety of people at work. This gradual shift of focus has been driven by the awareness that Human Factors rather than purely technical failures are prime causes of accidents in high reliability industries where significant hazards are present. As previously stated, they feature in 80% of all types of accident and in almost every major accident. Associated with the Human Factor dimension, many studies have identified that a significant number of accidents and incidents may be attributed to unsafe

work practices of the workers rather than unsafe working conditions (e.g. Garavan and O'brien, 2001). Some studies (Mullen, 2004) reveal that organisational and social factors are not to be discounted because these factors influence safety behaviours; if unsafe conditions prevail, they become normalised with the risks accepted and adapted to. Research has more recently demonstrated that by establishing a positive safety climate may lead to improvements in hazard recognition and improvements in risk perception (Pandit et al., 2019) potentially leading to accident and incident reduction through the Human Factor.

O'Connor et al. (2011) report a variety of qualitative and quantitative tools have been utilised for measuring organisational safety climate, of these, questionnaires are by far the most typically deployed. Payne et al. (2009) consider that safety climate assessments may be able to highlight where threats to safety lie in an organisation thereby allowing the targeting of available intervention resources. It is proposed that an effective safety climate measurement tool should capture shared perceptions but may not include other psychological constructs such as safety attitudes. Each individual respondent should be considered as an observer and reporter of the shared safety perception (Kines et al., 2011). Consistent with this, the HSL Safety Climate Tool, described as a reliable and valid psychometric instrument (Sugden et al., 2009), should facilitate such a measurement exercise and lead to the effective targeting of available safety climate intervention resources. This research instrument is described in further detail within Chapter 4. O'Connor et al. (2011: 264) concluded that "*The use of long and complex surveys should cease to be the measurement method for assessing safety climate*." They recommended that a triangulation approach with quantitative and qualitative aspects should be used to provide a detailed analysis of organisational safety climate as an element of safety [and organisational] strategy. The outcome was considered a vital concept within the current research and was used as primary driver within the methodology framework.

2.6 LEADERSHIP

At the UK Oil & Gas Piper 25 Conference, along with appropriate business strategies, the Head of Strategic Intervention HSE Energy Division espoused the need for effective safety leadership (Hackitt, 2013). The espousal reflected the Regulators recognition that no matter how well strategy is established, defined, and communicated it requires to be effectively implemented if organisational goals and objectives are to be achieved. Effective leadership is therefore required at each strategy level (corporate, business, and functional).

There are numerous definitions of leadership. For example, Flin and Yule (2004) consider leadership to encompass the skills relating to influencing a group to attain a specific set of organisational goals. Babcock-Roberson and Strickland (2010) view leadership as a social influence process where one or more individuals prevail upon one or more followers by explaining the tasks to be accomplished then subsequently providing the means and motivation to achieve established goals. Mullins (2010: 373) provides a synthesis defining it as "*a relationship through which one person influences the behaviour or actions of other people"* Some forty years ago, Cohen (1977) concluded that strong management commitment to safety plus close contact and interaction between workers, supervisors, enabling open communications on safety were clear distinguishing factors for successful safety programs and safety performance.

Safety leadership is deemed to be a sub-set of leadership that can be defined as "*the process of interaction between leaders and followers, through which leaders can exert their influence on followers to achieve organizational and safety goals under the circumstances of organisational and individual factors*" (Wu et al., 2008: 308). These interactions are vital within the oil and gas industry due to the high level of organisational complexity and the safety critical nature of production operations. In this research context, strategic and operational leadership within the industry are required to influence or perhaps transform safety behaviours of personnel from across the value chain (i.e. Operators, Contractors and Sub-contractors with inherent and differing

safety standards) to meet the safety performance expectations of asset Operators and Duty Holders.

Previous studies have investigated the outcome of safety leadership on safety performance (O'Dea and Flin, 2001; Barling et al., 2002; Neal and Griffin, 2006; Zohar, 2010; Griffin and Hu, 2013; Fernandez-Muniz at al., 2014; Pilbeam et al., 2016; Wu et al., 2016; and Fernandez-Muniz et al., 2017). Safety leadership combined with safety culture are two important predictors of a good safety performance and in developing a positive safety climate. Wu et al. (2008: 315) consider it necessary for senior management and managers "*to demonstrate visibly the strongest commitment and action on a regular basis*". This indicates a need for high level safety leadership to encourage the operational supervisors to influence group safety. Consistent with this position, Kapp (2012: 1123) identifies the value of leaders and supervisors "… *who are perceived to place a high value on safety achieve greater levels of safety compliance from their employees* …"

Effective managers and supervisors can directly and indirectly influence workforce behaviour (Mullins, 2010). Indirectly, they establish and reinforce norms relating to working practices and procedures thereby influencing safety culture and climate. Directly, their portrayal of safe and unsafe behaviours and the reinforcement of behaviour through interaction, monitoring, control, intervention, and reward are significant. These leadership actions influence workforce expectations and motivation thus impacting upon behaviours (activity) and (safety) outcomes. As such, effective leadership behaviour affects safety culture and indirectly affects safety performance (Yang et al., 2009). Safety leadership is a multifaceted role requiring leaders and supervisors to engage with the workforce on a personal level and to possess a consistent and systematic view of organisational safety practices. The skill inventory (Figure 2.5) highlights four skills that leaders need to possess to build a safe and dynamic work environment (Griffin and Rodriguez, 2013). As a result of personal correspondence with authors Griffin and Talati (2013) it was established that the existing safety culture of an organisation may influence the kind of leaders who are attracted to it.

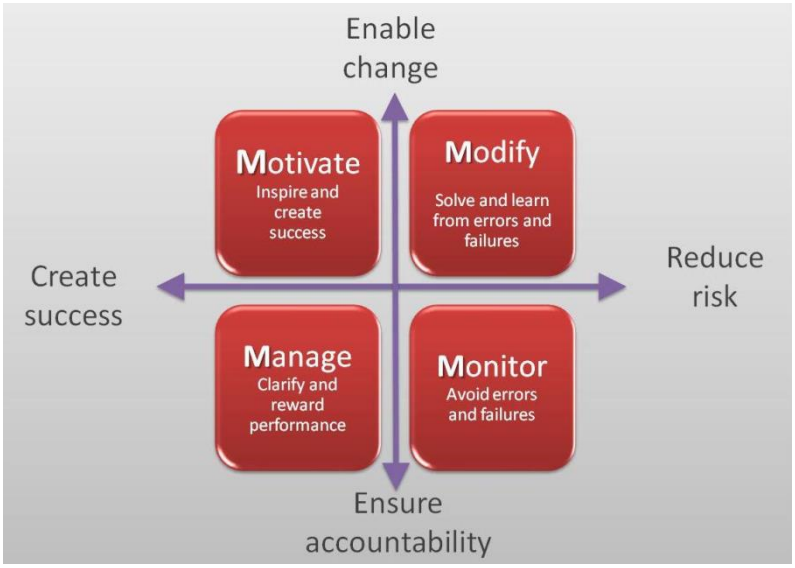

Figure 2.5 Four Skills Required for Safety Leadership, adapted from Griffin & Rodriguez (2013)

In a study of safety compliance on offshore platforms, Dahl and Olsen (2013) noted that in addition to having a direct effect on safety compliance, a high level of leadership involvement was critical to the formation of a climate that that stimulates compliance with rules and procedures. It was further highlighted that appropriate leadership training is necessary when aiming for improved safety compliance.

Safety research has drawn some parallels between safety leadership and transformational leadership (Barling et al., 2002; Mullen and Kelloway, 2009; and Conchie, et al., 2011). Of the many leadership theories, transformational leadership rather than transactional leadership has been considered extremely pertinent in achieving improved safety behaviours because it is a process of engendering higher levels of motivation and adherence among followers (Mullins, 2010). Transformational leadership is composed of four elements (Barling et al., 2002): idealised influence; inspirational motivation; intellectual stimulation; and individualised consideration. In a comparison of safety-specific versus general transformational leadership Mullen and Kelloway (*ibid*: 255) summarised that "*a safety-specific transformational leader engages in behaviour that is characteristics of the components of transformational leadership, yet specifically focused on inspiring and promoting positive safety-related practices*". Transformational leadership is considered a positive leadership style (e.g. Bass, 1998) along with others such as charismatic (Conger et al., 2000; Jacobsen and House, 2001;

Babcock-Roberson and Strickland, 2010; de Hoogh et al., 2010; and Dartey-Baah and Addo, 2018) and ethical (Brown et al., 2005).

Charismatic leaders were described by Bass (1985) as possessing strong referent power with associated influence. Further conceptualised by Conger and Kanungo (1987), Charismatic leadership was described as possessing three stages through which a leader must take an organisation from present times through to the future operations: first, the environmental assessment stage; second the vision formulation stage; and finally the implementation stage. Individuals choose to follow such leaders in a workplace setting, not from formal designation of position and associated power, but due to the perception of the leaders [apparently extraordinary] character. Kark, Sghamir and Chen (2003) as cited in Babcock-Roberson and Strickland (2010) considered that charismatic leaders influence their follower's social identification that I turn influenced their follower's sense of empowerment. With follower's empowered they develop a genuine belief that they are capable of influencing outcomes at work to make a value-adding difference. This constitutes evidence that charismatic leaders exploit, to their own advantage, the dynamics of social interaction in the workplace.

To define and visualise ethical leadership, Brown et al. (2005) evoked social learning theory (Bandura, 1977; Bandura, 1986) to suggest that ethical leaders influence their employees through observational learning, in which employees learn by proxy from witnessing ethical leaders' behaviours and subsequent consequences (Bandura, 1977; Bandura, 1986). Ethical leadership is defined by Brown et al. (2005: 120) as "*the demonstration of normatively appropriate conduct through personal actions and interpersonal relationships, and the promotion of such conduct to followers through two-way communication, reinforcement, and decision-making*". According to Mayer et al. (2009), ethical leaders concentrate entirely on the ethical dimension rather than on ethics as an aspect of leadership. Adding to the concept further, Brown et al. (*ibid*) concluded that ethical leadership incorporates two dimensions: firstly, traits such as honesty, fairness, and morality; plus behaviours exampled by balanced decision making, promoting ethics within the workplace and managing with a moral perspective. Dust et al. (2018) also suggested that ethical leaders influence their employees'

psychological empowerment through social learning processes with subsequent positive motivational implications. Dust et al's (*ibid*) research advocates that ethical leaders are proficient role models who strive to bring out the best in their employees through psychological empowerment, in turn facilitating employees' current success plus their future success potential.

However, the current research considered authentic leadership, with roots firmly anchored in positive psychology and positive organisational behaviour (Luthans and Avolio, 2003) to be a positive leadership style worthy of extended scrutiny. Authentic leadership is a combination of the moral and ethical components of leadership; they care about other people and society. Avolio and Gardner (2005) defined authentic leadership as having several key components: positive psychological capital; a positive moral perspective; leader self-awareness; leader self-regulation; leadership processes or behaviour; subordinate self-awareness or regulation; plus a genuine interest in subordinate [follower] development. Jensen and Luthans (2006) subsequently determined three characteristics of authentic leaders: firstly, they are motivated by personal beliefs rather than the attainment personal benefits; secondly, they are original in character and nature rather than being attempted copies of someone else; and finally, their actions are based on personal values. From these perspectives on authentic leadership, Eid et al. (2012) proposed the leadership style to be worthy of inclusion in future research to determine how leadership may affect safety outcome in safety critical organisations such as the Offshore Oil & Gas Industry.

The establishment of authentic leadership as an accepted construct is the direct result and reflection of its multiple underlying dimensions; it lies at a junction of leadership, ethics, and positive organizational studies (Avolio et al., 2004; and Cooper and Nelson, 2006). Luthans and Avolio (2003: 243) defined authentic leadership as the "*process that draws from both positive psychological capacities and a highly developed organisational context, which results in both greater self-awareness and self-regulated positive behaviours on the part of leaders and associates, fostering self-development*". Such a leader operates in neither the vacuum of self-interest nor under the organisational '*Dulce et Decorum Est pro patria mori'* banner (Owen, 1920). In this context, authentic leaders sustain and develop based on their

psychological abilities plus their highly developed organisational contexts to achieve positive results. This results in self-development for both themselves and their [supporting] associates. There is an extrapolated expectation of resultant positive influence on subordinates which, in turn, has made the authentic leadership construct a subject of significant interest to the academic research. There have been numerous research studies conducted during the past two decades to examine the role of authentic leadership in multi-faceted organisational aspects such as employee job satisfaction (du Plessis and Boshoff, 2018), and safety perception (Gardener et al., 2005: Iverson, 2005; Neilsen et al., 2011; and Eid et al., 2012*).* It was concluded by Neilsen et al. (2011) that the four elements of authentic leadership (namely transparency, internalised moral perspective, balanced processing, and self-awareness) are integral components of leader-follower exchanges that can contribute to worker perceptions of safety climate, also to subsequent hazard and risk perception in the workplace of safety critical organisations such as those in the UK Offshore Oil & Gas Industry.

For the current research, authentic leadership was selected to be a primary point of focus because, regarding matters of safety, the leadership style directly affects safety outcomes through the promotion of positive safety climate perceptions (Nielsen et al., 2011; Eid et al., 2012). Authentic leaders are also noted to augment engagement, motivation, commitment, and the involvement required by associates and subordinates to continually improve their performance outcomes through their evolution of both personal and social identification (Avolio et al., 2004).

2.7 SOCIAL DYNAMICS AND PSYCHOLOGICAL PROCESSES

Hopkins (2012) in analysing the 2010 Gulf of Mexico Macondo disaster identified that social psychological processes had contributed to a sense of denial regarding a possible well blowout and subsequent catastrophe. Those processes were confirmation bias, normalisation of deviation, inadequate situational awareness, and groupthink. The four processes are an integral part of group dynamics, the influential actions, processes, and changes that occur between and within groups.

Confirmation bias is pervasive and strong and, according to Nickerson (1998) refers to the seeking or interpretation of evidence in a manner that is partial to existing beliefs, expectations, or a hypothesis to the fore. Schultz-Hardt et al. (2000) confirmed that confirmation bias existed at group as well as the individual level; significant in many workplaces since a considerable number of decisions (e.g. safety critical ones) with far-reaching implications are made at a group rather than individual level. Schwind and Buder (2012) consider confirmation bias to reflect a trait for the selection of preference-consistent information, a hindrance from taking dissenting information into account during decision making and, ultimately, an impediment to critical thinking.

Normalisation of deviation is a phenomenon recognised in the aftermath of the Space Shuttle Challenger disaster, January 1986 where subsequent studies of the NASA organisation revealed a series of mis steps, flawed assumptions and a culture of risk taking in the run up to the fatal launch (Vaughan, 1996). Pinto (2014) succinctly summed the phenomenon up as "*the unexpected becomes the expected, which becomes the accepted*". This drift into failure has become acknowledged to be gradual in action, where individuals in an organisation may only recognise the deviance [it appears normal at the time] only with the benefit of hindsight. Further, the drift and acclimatisation to deviant behaviour takes place as a stepped process, over an extensive time period (Starbuck and Milliken, 1988); unacceptable behaviours do not all occur at once, rather they may be considered as the summation of multiple decisions. In this way, the potential for accident is never seen to be a realistic outcome until it realistically occurs, and only then becomes recognisable through hindsight.

The concept of situational awareness, a cognitive skill, refers to individuals having an accurate and clear picture of the crucial factors comprising their environment (Saetrevik and Hystad, 2017). Endsley (1988: 97) defined situational awareness to be "*the perception of the elements in the environment within a volume of space and time, the comprehension of their meaning, and the projection of their status in the near future*" and wider research indicates that loss of situational awareness is correlated with poor system performance (Stanton et.al., 2001). Flin et al. (2015) consider that since situational awareness influences both performance and decision making

it has a crucial role to play in safety performance outcomes. Further, research conducted by Sneddon et al. (2013) concluded that higher levels of stress and fatigue are associated with lower levels of situational awareness, an increase in unsafe behaviours and higher accident risk potential. Overall, Salmon and Stanton (2013) considered the body of research conducted demonstrated situational awareness to be a salient safety-related concept.

Groupthink is essentially "*the tendency of cohesive groups to reach consensus on issues without offering, seeking, or considering alternative viewpoints*" (Lunenburg, 2010: 1). Janis (1972, 1982) introduced the term from studies based primarily on political and military decision making; Lunenburg (*ibid*) subsequently confirmed that the potential for groupthink exists in any organisational setting. In a recent review, Waring (2015) noted additionally that groupthink consensus is frequently built around an authority figure despite the figure's view perhaps not being supported by factual evidence to permit data-driven decision making; or necessarily be in the best interests of the group members. Waring (*ibid*) identified groupthink as being a contributor to inappropriate decision-making and subsequent actions in the lead up to safety disasters. Waring's conclusions resonate with Janis's (1971) belief that Groupthink, as a by-product of group decision making processes, is endowed with a consensus-seeking conformity so strong and fuelled by group cohesiveness it is capable of restricting and destroying the decision-making process.

Forsyth (2019) notes that individuals frequently utilise groups to solve problems and make decisions in the belief that groups can process more information, more thoroughly, than individuals working alone. The intent of such group decision-making is fundamentally to ensure effective decision making that leads to safe operation and the prevention of accident and incident. However, as seen with Macondo, there exists a negative side of group dynamics that must be addressed when considering safety barrier elements and loss causation. Forsyth (*ibid*) noted that when rationality is put aside by a group in pursuit of unity, subsequent decisions have the propensity to deliver disastrous consequences

Storseth et al. (2014) in their re-analysis of the Hopkins 2012 study stated that the four specific psychological mechanisms identified by Hopkins are infused with social context, specifically a triumvirate of persuasion, pressure, and power. Macondo was deduced to be an extreme example of where the social forces existing within the work group onboard [the drilling rig] subdued attempts to think differently in the lead up to the disaster. The identified psychological mechanisms combined to defeat the established technical, operational, and organisational safety barrier elements established to prevent such a major accident event. In the same way in which psychological forces can serve to disseminate organisational strategies, processes, procedures, and decisions through a whole barrier system they may also contribute to the transmission of risk potential.

2.8 BUSINESS STRATEGIES FOR INDUSTRY SAFETY CHALLENGES

At the UK Oil & Gas Piper 25 Conference, the Head of Strategic Intervention HSE Energy Division (Hackitt, 2013) highlighted that to meet and overcome present-day safety challenges it would be essential for organisations to develop, implement and sustain appropriate business strategies. Before considering safety strategy as a specific topic subset, a review of the strategy topic from a more holistic perspective is provided.

2.8.1 Strategy

For several decades, the formulation of strategy and strategic management has been an important element within the private sector industries (Grandy and Mills, 2004). A factor relevant to the research given that the value chains of Oil & Gas Operators in the UKCS are typically comprised of private sector organisations. Strategy is viewed as the key to successful business operations through increased competitiveness (Finlay 2000; and Johnson et al., 2011) while obtaining and sustaining strong competitive advantage is a critical task for organisations (Aggarwal, Siggelkow and Singh, 2011). At the same time, however, the lack of a general model of organisational strategy content persists (Steensen, 2014); such a model would [ideally] include the distinctive and individualistic organisational characteristics to enable discourse on the effects of different components of organisations' strategy.

The concept of strategy has been extensively written about within management texts, with numerous and different meanings nascent from the literature. For example, strategy has been viewed as an organisation's formally stated goals, objectives, policies, and plans (Andrews, 1971; Hofer and Schen-del, 1978; James, 1984). Some authors advocate that strategy is best viewed as the general language and narrative used by managers as an attempt to give meaning and to influence the behaviour of organisation members (Pfeffer, 1981; Barry and Elmes, 1997; and Eccles and Nohria, 1998). Other authors have defined strategy as managers' intentions of reaching a unique competitive position (Porter, 1979), building a resource base (Barney, 1991; Peteraf, 1993) or testing opportunities inside specific boundaries for future activities (Eisenhardt and Sull, 2001; and Markides, 2004).

In a similar manner, academics and researchers have analysed and described different applications of the strategy concept. For example, several outcomes have categorized applications as strategy 'models' (Chaffee, 1985; and Ansoff, 1987), 'perspectives' (de Witt and Meyer, 1998; Whittington, 2001; and Jenkins and Ambrosini, 2002), 'lenses' (Johnson et al., 2011) or notably as 'schools of thoughts' (Mintzberg, 1990; Mintzberg and Lampel, 1998). Although these contributions generally emphasize differences between strategy researchers' focus and the basic premises of their work, they are not necessarily relevant in relation to defining the content of an organization's strategy; more specifically, how to identify the distinctive and individualistic compositions of organizations' strategy content.

Several attempts have been made to classify an organization's strategy content (for example Hax, 1990; Peattie, 1993; and Moncrieff, 1999). Possibly the most celebrated work is Mintzberg's (1987) 'The Strategy Concept 1: Five Ps for Strategy', that describes five ways of defining the strategy concept: as a plan; ploy; pattern; position; and perspective. Mintzberg claims that each definition competes, but also complements, and adds important elements to an understanding of what strategy is. The inadequacy in applying such frameworks for generally understanding the distinctive and individualistic content of organizations' strategy can be exemplified by Mintzberg's 'five Ps' framework. First, three out of Mintzberg's

five types cannot be assumed to be present in all organizations. Not all organizations have thought out something that can be viewed as a 'strategy plan', search for a specific position or articulate ploys to mislead competitors. Thus, the framework may not be relevant for describing the strategy content for all organizations. Further, the framework does not address the relations between the five defined types of strategy. This is problematic because interaction between strategy types may be critical in understanding the distinctive and individualistic characteristics of an organization's strategy content, e.g. whether 'plan' or 'position' relates to 'pattern' in any one specific organisation. Moreover, Mintzberg's model and those of Peattie (*ibid*), Hax (*ibid*), and Moncrieff (*ibid*) leave out the question of how the strategy of an organisation is composed since there may not be one plan, ploy, search for position, pattern, or perspective in an organization, but many (formal and informal) among key influencers (plans, positions, perspectives). These may be relatively concurrent in some situations but diverse and conflicting in others. Such seminal contributions emphasize, however, the need for redefining organisational strategy content in a less rationally mechanistic manner; one that acknowledges multiple and potentially conflicting aspects thus considering organizational level diversity in strategy content level. This is described as the need to move from a 'mechanistic' to an 'organic' perspective on strategy, where '*in the organic view interaction and mutual influences are highlighted*' (Farjoun, 2002: 570). With respect to strategy in-practice, such a perspective strongly indicates that [for successful implementation] organizational strategy requires evolution to being more adaptively emergent rather than rationally deliberate and functional. Indeed, the "*myth*" of organizational effectiveness through instrumental rationality is strongly disputed by Stacey (2007: 300, 301) who advocates that "*change emerges in predominantly unpredictable ways*", particularly in complex organizations such as many included in Oil & Gas Operator value-chains, where complexity may never be fully known, understood, or controlled (Stacey, 2009).

2.8.2 Strategic Management

Strategic management involves formulation and implementation of the major goals and objectives undertaken by an organisation's top management on

behalf of shareholders (Nag, Hambrick and Chen, 2007). This includes consideration of available resources plus an internal and external assessment of the environment in which the organisation competes. Studies on strategy can, from a broad perspective, be differentiated into two types. Firstly, one that prioritises the analysis of an organisation's external environment such as Porter' (1980) model and one that takes more account of the internal environment, as in the Resourced Based View (RBV) model (Wernerfelt, 1984). Porter (*ibid*) emphasises that the source of competitive advantage is related to an organisation's positioning, and therefore, it must identify and locate to a position from which it is capable of defending itself against environmental forces with the potential to detrimentally affect its competitiveness and results. The resource-based view (RBV) perspective (Wernerfelt, *ibid*) analyses internally for the sources of competitive by recognising the heterogeneity of organisations. In their seminal adaptive cycle research, Miles and Snow (1978) placed themselves philosophically in between the Porter and RBV views of strategy and strategic process. The presented logic was that organisations must adjust their strategies to the experienced and prevailing environmental conditions and align its structures to the established strategies, therefore ensuring that process of obtaining strategic fit purpose becomes dynamic in nature. In the view of Miles and Snow (*ibid)* achieving strategic alignment is not an isolated event but rather a continual process of adaptation and change.

Miles and Snow (*1978*) proposed four basic types of strategy for business, recognising there may be nuances of difference depending upon the nature of the industry [being observed]. Firstly, Defenders are organisations that prosper through stability plus reliability, and efficiency. Secondly there are Prospectors, organisations that generate success by utilising market and product opportunities in a stimulating manner. Analyzers are successful by being more innovative in both product and market initiatives than Defenders albeit more cautiously and selectively than Prospectors. Reactors are the most likely of the four organisational types to not prosper since they tend to hesitate in their approach to the external environment. The four basic types of strategy were overlaid by Miles and Snow (*ibid*) with the concept of an adaptive cycle, interpreting organisations to be perpetually engaged in their own entrepreneurial problem (selecting and adjusting to the market-product

domain), their engineering problem (producing and delivering their products and services) and finally their administrative problem (establishing the necessary roles, working relationships, and processes). The Miles and Snow (*ibid)* deduced logic was that through enough rotations of the adaptive cycle an effective organisation becomes aligned with either Defender, Prospector, or Analyzer typology. Failure to grasp the alignment opportunities presented by the adaptive cycle inevitably leads to alignment with the Reactor typology.

Miles and Snow (*ibid*: 30) acknowledge that any one typology is unlikely to encompass every form of organisational behaviour given that that the world of organisations is "*too changeable and complex to permit such a claim"*. With organisations proceeding through the adaptive cycle, perhaps continually over time, there will inevitably be some that organisations identify between the defined typology types. The Miles and Snow typologies has been consistently and widely adopted in strategic research (Desarbo et al., 2005; Lin et al., 2013; and Helmig et al., 2014) since their 1978 inception, primarily due to their applicability to all business types and industry applications. Miles and Snow (*ibid*) predicted that their typology designations would support codification and prediction in research. However, no application of the Miles and Snow typology was identified for use in the Offshore Oil & Gas industry, hence originality of the current research.

Considering strategy formulation, Hart (1992) produced a typology of five strategy-making modes that has gained wide acceptance as a theoretical model. The typology has implications for the research through outlining alternative processes for strategy formulation with which differing value chain organisations may adopt. In the Command Mode strategy is made by a strong individual leader supported by a few top managers. Analysis and option evaluation become used to provide deliberate, fully formed, ready to implement strategies. Other people in the organisation are 'good soldiers' who execute the strategy. This might work in an industry environment that is relatively simple and hence can be understood by one or a few people. The organisation will probably be relatively small, so that one person can still maintain effective control.

In the Symbolic Mode, top management create a clear and compelling vision, which gives meaning to the organisation's activities and provides a sense of identity for employees. This long-term vision can be translated into specific targets and there is an implicit control system based on shared values. Speeches, persuasion, new projects, and recognition provide focus and momentum to guide the creative actions of individuals. The flexibility of this mode is said to suit dynamic environments, and larger more differentiated organisations which may be growing or re-orienting through proactive strategies; this is well aligned with Miles and Snow typologies of Prospector or Analyzer. In the Rational Mode, there is a more comprehensive system of formal strategic planning with written strategic and operating plans. There is upward sharing of data and a high level of information processing and analysis. Detailed plans and well-developed control systems are seen. It is likely to be found in larger firms defending established strategic positions in relatively stable environments; aligned with the Miles and Snow typology of Defender. The Transactive Mode employs strategy making based on interaction and learning rather than the execution of a predetermined plan (which is precluded by the inability of top management to understand a complex environment fully). Features of this mode are cross-functional communication, feedback and learning, and dialogue with key stakeholders, thus necessitating an iterative approach to strategy making. Initiatives such as just-in-time (JIT), total quality management (TQM) and customer focus provide vehicles for these transactions. Top management is concerned with facilitation and linking outcomes over time to determine strategic direction. This is said to suit large mature firms operating in complex environments, e.g. following analyser strategies aimed at incremental product or service improvement. Finally, the Generative Mode has features that were also highlighted in the work of Wooldridge and Floyd (1990). New ideas emerge upwardly from "entrepreneurship". Top managers mainly encourage experimentation and select and nurture high-potential proposals. New strategies are germinated by separating innovative activity from the day-to-day work of the operating organisation. Product champions, who can link new ideas with organisational resources to make them a commercial reality, are important. The strategy is continuously adjusted to reflect the pattern of high potential innovations that emerge from below. This mode is said to suit

turbulent environments, and Prospector strategies in complex and fragmented markets.

Hart's later empirical work (Hart and Banbury, 1994) produced evidence that the more capable an organisation was to develop competence in multiple modes of the strategy-making process, the higher its performance. Firms able to accumulate more complex resources and capabilities in strategy making should be more successful at sustaining competitive advantage than those firms with simpler or less-developed capabilities (Barney, 1991, cited in Hart and Banbury, 1994). In turn, environmental analyses are an active and essential input into an organization's strategic development; it is categorically not a 'passive' exercise (Fitzroy et al., 2012: 93). The strategic tools and techniques utilised are imperative for business, to maintain competitiveness and effectiveness. Wright et al. (2013:92) conclude from research in the field that "they form a critical and cognitively demanding element in the practice of effective strategy workers".

2.8.3 International Oil Company (IOC) Strategic Approaches

IOC's, during the past five decades, have been predominantly responsive to changes in their external environment resulting in changes to the strategic architecture of the companies themselves. In the early days of the Oil & Gas Industry (i.e. early 19th century from when the first commercial oil well was drilled in North America – 1818) through to mid-20th century the predominance appears to have been the dynamics of advantage leading to the 1950's when seven giant oil companies owned approximately 85% of global reserves. Such enormous organizations had similar tendencies to those of mass-production industries and governments with strategies rationally deliberate and controlled in nature (Lampel et al., 2014). Since that period, the competitive market of IOC's has been assailed by a range of diverse factors and challenges: market conditions; political; geological; and technical (Labban, 2010; Casertano, 2013; Mitchell and Mitchell, 2014). The oil price collapse towards the end of the 1990's resulted in a series of mergers and acquisitions that eradicated former prominent independent oil company names (Mohn and Misund, 2009) as a consequence of the strategic phase to improve competitiveness. Casertano (*ibid*: 212) comments that the oil

companies have reacted with "remarkable strategic flexibility" during this period of significant change, but the flexibility was noted to be reactive in nature.

During the 1990's when the global oil and gas industry was experiencing a phase of turmoil, mergers, and acquisitions (Mohn and Misund, 2009) the Business Scorecard (BSC) model first introduced by Kaplan and Norton (1992; 1996) was gaining traction. At this time, the strategies deployed by IOC's were considered responsive rather than emergent in nature. The BSC is a technique used to establish a structure capable of translating an organisational strategy into operational terms. The aim of the BSC (Figure 2.6) is to translate the organizational mission and strategy into a comprehensive set of performance measurements which become the basis for a strategic performance measurement system.

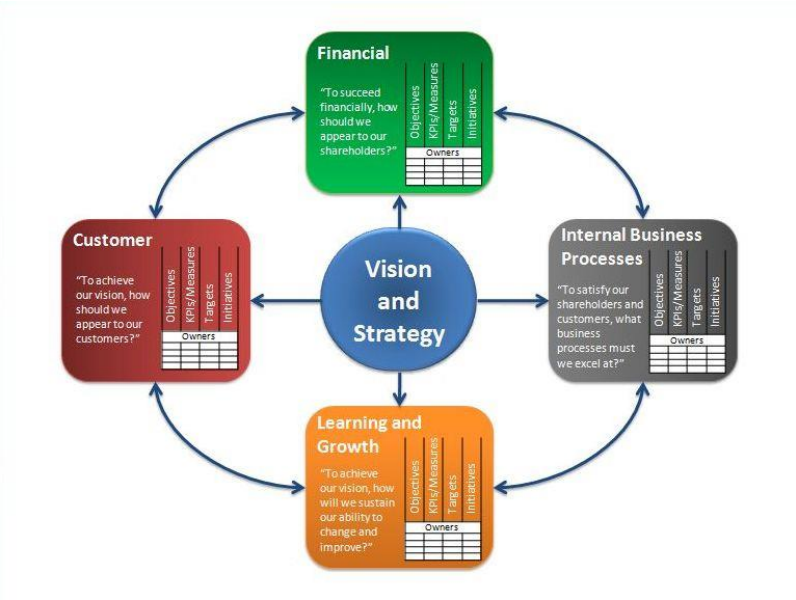

Figure 2.6 Balanced Scorecard Model, adapted from Kaplan and Norton (1996)

By employing a BSC-based approach many Oil & Gas Operating companies adopted a rational functionalist approach that focuses on scientific reductionism resulting from dividing the organizational mission and strategy into constituent variables. However, research has concluded that such rational paradigms may fail when confronted with unpredictable and unstable environmental conditions (Stacey, 1995; Combe and Botschen, 2004). As Casertano (2013) and Ermida (2014) acknowledged, oil companies have been subject to a constantly changing environment during the past forty years. By

reacting to environmental change through a predominantly rational, deliberate, and functionalist approach may have served to limit rather than maximise company competitiveness.

The BSC has more recently come in for additional criticism. Flamholtz (2003) concluded that if factors used in the BSC were invalid then the organization may focus on the wrong strategic aspects with potentially damaging consequences. Voelpel et al. (2006:43) refer to "*The tyranny of the Balanced Scorecard in the innovation economy*", concluding that the BSC has become obsolete due to competitive nature in business fundamentally changing since the BSC's inception. A concept developed to address twentieth century economic and strategy paradigms cannot be effective in an economy that has evolved from industrialised to innovative; it does not sufficiently address emergence in organizational environments. Specifically, Voelpel et al. (*ibid*) advocate that the BSC exhibits severe limitations when applied to a rapidly changing and networked corporate environment. Effective use of the BSC is also challenged due to senior management's remaining inclination to use traditional financial measures as the primary factor to demonstrate successful strategy implementation (Chia et al., 2009). Further, culturally the BSC has been criticised for being a product of the USA, where performance-based remuneration systems are the norm (Bourguignon et al., 2004). However, many Operator organisations active within the UK Oil & Gas Industry have strong American corporate links with those values embedded and therefore there may be less of an ideological mismatch through use of a BSC-based approach.

The "*myth*" of organizational effectiveness through instrumental rationality is strongly disputed by Stacey (2007: 300, 301) who advocates that "*change emerges in predominantly unpredictable ways*", particularly in complex organizations such as IOC's where complexity may never be fully known or controlled (Stacey, 2009). Change in such organizations requires complex responsive processes (Stacey et al., 2000), not a structured and rational systems approach. This logic applies equally to the driver of performance excellence – environmental, ethical and safety (section 3.5). To ensure maximum benefit, IOC strategy practice requires evolution to being more adaptively emergent rather than rationally deliberate and functional as per

the existing BSC approach. This evolution, by necessity of strategic alignment, may extend into organisations (contractors and subcontractors) that [typically] comprise an IOC's value chain. To counter criticism of the BSC, Kaplan and Norton (2006) published a response to Voelpel et al. (2006). The response is professionally scathing and provides rebuttal to the five alleged failings. It states that the BSC may be used with additional perspectives in addition to the essential four; the tool is a means of adapting strategies through changing knowledge and economic conditions; the revised BSC includes external focus and relationships and is not limited by an internal perspective only. Furthermore, innovation can be incorporated within the BSC; and it must be adapted for use in an uncertain environment as part of a dynamic strategy management system – it does not have to be tyrannically mechanistic with linearity limitations. Kaplan and Norton (2006) have also presented an approach to successful strategy application, utilising the '*improved*' BSC as part of a closed loop management system model; their model is shown in Figure 2.7.

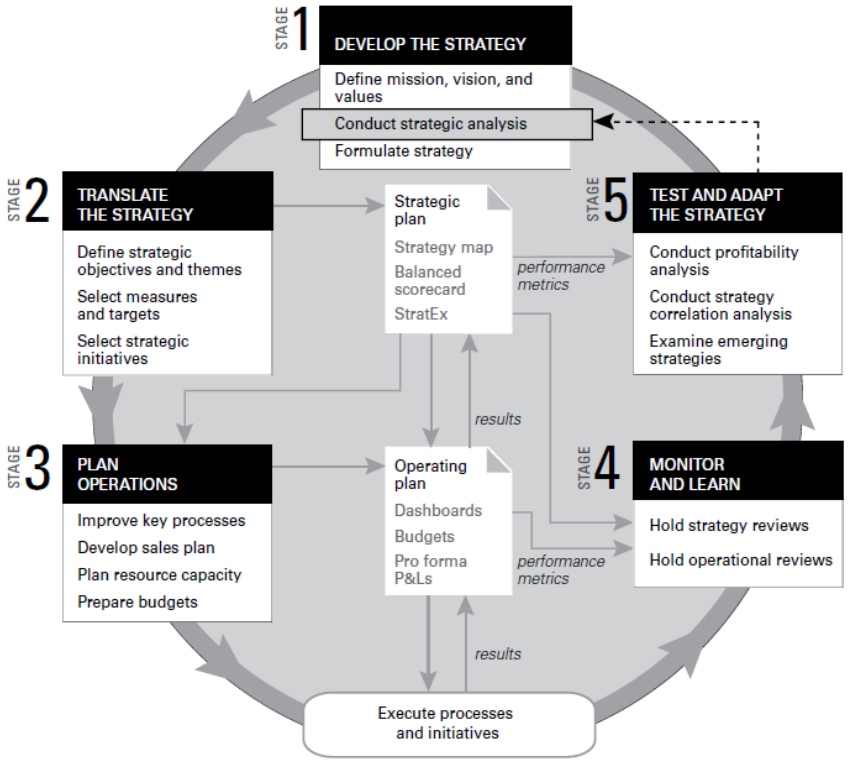

Figure 2.7 Closed-Loop Management System Linking Strategy and Operations, taken from Kaplan and Norton (2006)

IOC's desiring to retain a BSC-based approach to strategic management practice the company may benefit from reviewing the modified and more

adaptively emergent BSC as well as the closed-loop management system model. Stages 1 and 2 of the Closed-Loop Model provide a clear opportunity for the inclusion of safety strategy elements, e.g. safety climate and HF aspects, as a means of improving safety performance outcomes and enhancing organisational competitive edge.

2.9 MANAGING FOR OFFSHORE SAFETY ACROSS THE VALUE CHAIN

One of the biggest challenges to achieving successful safety performance on offshore assets is managing the working relationship between Contractors, Sub-contractors, and the Operator company that they work for (Sutton, 2014). As such, these workers are involved in many activities with the potential to initiate Major Accident Hazard events in addition to occupational accidents (slips, trips and falls), as noted by Hopkins (2102) in his analysis of the Deepwater Horizon incident. Given the diversity of Contractor and Sub-contractor organizations across the value chain (small and medium sized enterprises with fewer than 250-employees, micro-businesses with fewer than 9-employees, through to self-employed personnel) a one-size-fits-all approach to contracting and safety management is considered most unlikely (Offshore Safety Management, *ibid*).

Within the UK Offshore Oil & Gas Industry, Contractor and Sub-contractor organisations are typically subject to a risk-based safety evaluation and selection process to assess fit and suitability with the Operator company's safety management system. This activity is typically and initially conducted as part of pre-contract award supply chain activity; subsequently performed at periodic intervals during the lifetime of the [awarded] contract based on assessed risk or identified need (poor safety performance). To facilitate the evaluation and selection process, many Operator companies participate in the Achilles FPAL Verify audit program (FPAL, 2020) which is an onsite management system audit that covers Health & Safety, Environment, Quality and Competence & Training practices. The Health, Safety and Environmental elements of the FPAL Verify audit are consistent with recognised industry standards IOGP 423 and NORSOK S-WA-006:2018. Other Operator companies self-manage evaluation and selection processes, similar to FPAL Verify, these self-managed programs are typically based upon international

safety management system standards such as ISO 45001:2018 Occupational health and safety management systems, the UK Health and Safety Executive's HSG 65, the Tender Efficiency Framework (OGUK, 2017), and the NORSOK Standards S-WA-006 HSE-evaluation of contractors standard.

The standards anchoring Contractor and Sub-contractor evaluation and selection processes are nationally and internationally recognised. Their tie-back to organisational strategy may be considered delicate and open to a range of interpretations. For example, ISO 45001:2018 merely states "*ensuring that the OH&S policy and related OH&S objectives are established and are compatible with the strategic direction of the organization*". The other requirements contained in the standard are detailed and therefore more straight-forward to audit and assess. From the same standard it becomes incumbent on the Operator company to ensure workers (Operator, Contractor, or Sub-contractor) are "*competent (including the ability to identify hazards) on the basis of appropriate education, training or experience*". Practical experience of the researcher identifies a natural default to technical competencies of operators and less so managerial competencies of supervisors and managers. Considering evaluation and selection of Contractors and Sub-contractors the standard makes it incumbent on the Operator organisation to "*ensure that the requirements of its OH&S management system are met by contractors and their workers*". Given that the majority of Contractor and Sub-contractor organisations have independent third-party certification to international safety management systems, assessment of alignment to an Operator's safety management system becomes relatively *easy* to evaluate without interrogating safety and business strategy alignment, Human Factors understanding, and safety leadership approaches adopted.

Management system standards contain a very rationally mechanistic approach to auditing, one based upon checking activities against governance, policy, and procedures and rules defining activities with the HSE Auditor drawing conclusions on the level of compliance observed from interview and documentary evidence of systems implementation provided (Le Coze, 2005). Further, the management system standards are not explicit in the management of psychosocial hazards and risk. Indeed, deploying

psychosocial audits (Bergh et al., 2014; and Jespersen et al., 2016) would provide a proactive and effective means for monitoring and subsequently managing the status of psychosocial factors influencing the risk of stress with accident-causing potential within the offshore workforce.

Gambetti and Marchi (2014) recognise the importance of Contractor and Sub-contractor HSE evaluation processes plus the need for evolution to generate improvement in the achievement of objectives and safety performance. However, their conclusions do not include a clear and detailed look at strategy, Human Factors (HF) or safety leadership.

Given the research is based on a typical UK Offshore Oil & Gas Operator's value chain, it is important to state that the Operator in question did not participate in the Achilles FPAL Verify audit process. Instead, it self-managed a risk-based Contractor and Sub-contractor evaluation and selection process based upon HSG65, Managing for Health and Safety plus ISO 45001: 2018 Occupational health and safety management systems.

2.10 SYNTHESIS OF THE LITERATURE

Several emergent, interdependent, and pivotal concepts were identified from critical review and the relationship of the key themes of literature review and concepts is depicted in Figure 2.8. Firstly, Piper 25's conclusion to a review of the Cullen Recommendations [Piper Alpha] questioning their current relevance given that in the UK Oil & Gas industry accidents and incidents still occur for 'old' reasons. The UK Regulator suggested that to meet these challenges, it would be essential for organisations working in the industry to develop and implement appropriate business strategies supported by effective leadership. The Piper 25 conclusion resonated that the industry remained predominantly focused on the engineering and technical aspects of safety. Secondly and supportive of this conclusion was Storseth et al. (2014) in the re-analysis of the Hopkins (2012) study of the Deepwater Horizon accident. They concluded that psychological mechanisms (the dynamics of social interaction) may have contributed to risk transfer across established safety barriers (technical, procedural, and organisational) thus contributing to the catastrophic disaster.

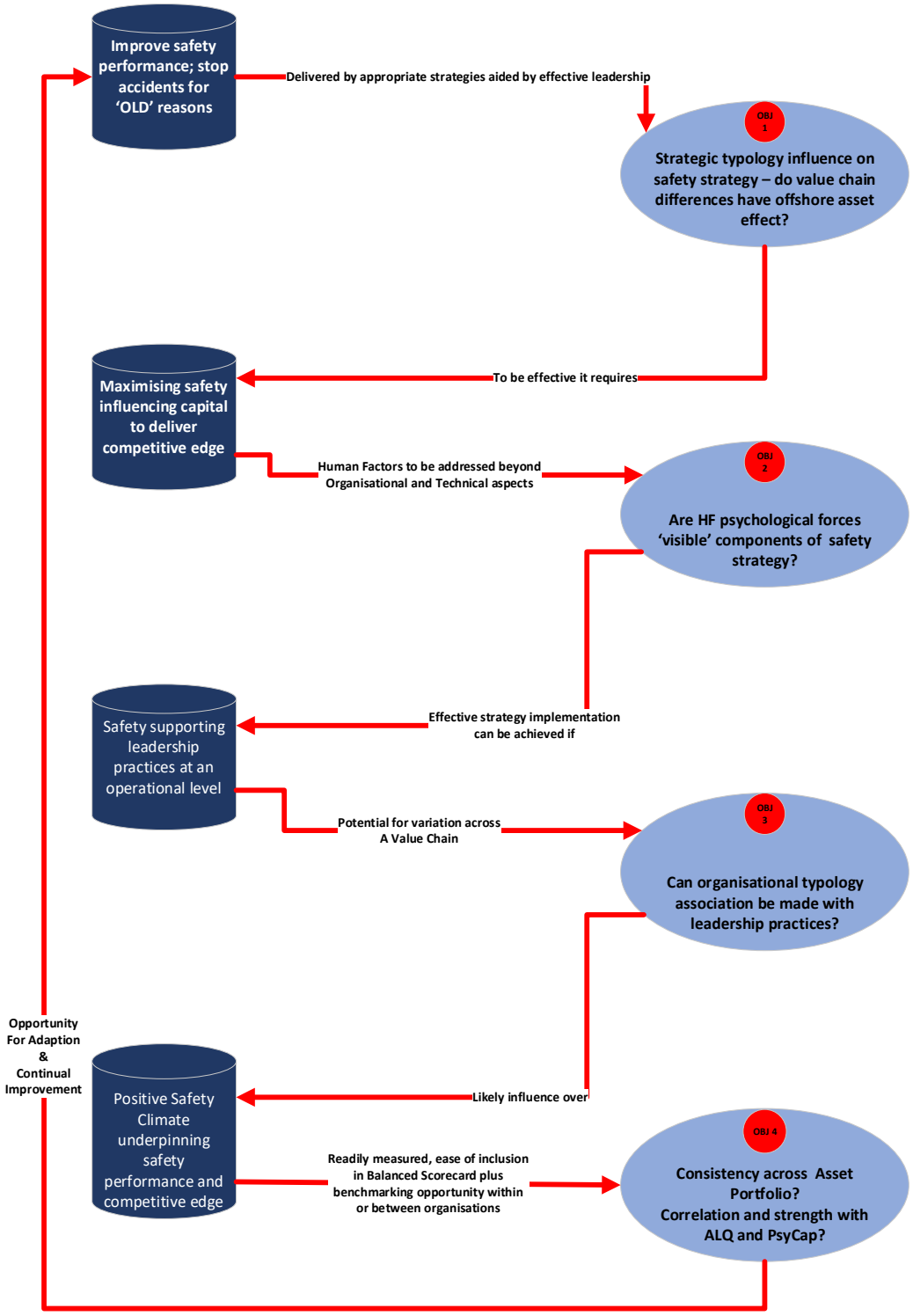

Figure 2.8 Literature Synthesis (Source - Researcher)

The researcher's considered the triangulation of persuasion, pressure and power within managers and supervisors as being capable of creating conflict with the planned arrangements for safety defences thus helping to defeat in-place barriers. It became a research imperative to determine the inclusion extent of the psychological forces element of HF in formalised safety strategies; lack of inclusion may detract from the appropriateness of strategy

that the UK Regulator was calling for. Thirdly, in critically reviewing strategy literature, it became clear that the Miles and Snow (1978) strategy typology had been both enduring and widely used in a wide variety of strategic research studies. The "*adaptive cycle*" and the deduced four basic strategy types of Defender, Prospector, Analyser and Reactor are acknowledged to still be relevant in reflecting the general business landscape. However, the researcher identified that the typology had not been utilised for Oil and Gas industry strategic and safety studies, therefore providing a uniqueness of purpose for the research undertaken. For strategy implementation to be successful the review clearly indicated that the important consideration of human capital must not be overlooked; this was the fourth concept identified. Human capital was highlighted as important to organisational competitiveness (Barney, 1991; Schultz, 1993; Rastogi, 2000; and Shaw et al., 2013) significantly noting the need for continual human capital development as a reflection of organisations' need for adaption to ever changing environments. The critical review also identified that accidents and incidents deteriorate human capital (through human cost and decreased productivity) thereby decreasing organisational effectiveness. Rastogi (*ibid*) purports social capital to be the base of human capital and the relationship resonates for safety performance. If trust, cooperation, and unity of purpose through social interaction become substantially undermined (a potential effect from the dynamics of social interaction) safety barrier arrangements may be defeated, resulting in accident and incident. Psychological capital (PsyCap), a form of positive organisational (Luthans, 2002) was the fifth concept emergent from the literature review as a psychological construct, when combined with appropriate leadership interaction, may promote greater safety awareness and safety performance (Mearns et al., 2012). In conjunction with the PsyCap review, a range of leadership styles were considered, with authentic leadership (Luthans and Avolio, 2003) particularly noteworthy due to such leaders enhancing engagement, motivation, commitment and involvement of personnel and teams necessary to continually improve performance outcomes through social interaction processes (Avolio et al., 2004).

Neilsen et al. (2011) also concluded that the four elements of authentic leadership are integral components of leader-follower exchanges that can

contribute to worker perceptions of safety climate, also to subsequent hazard and risk perception in the workplace of safety critical organisations, such as in the UK Offshore Oil & Gas Industry. The final concept to emerge was safety culture and climate, the latter being a measurable organisational frame of reference for safety-specific behaviours and attitudes of individuals and groups (Zohar, 1980; Clarke, 2006; Dahl et al., 2014). Measuring safety climate within a UK Oil and Gas industry value chain offered a real and innovative prospect, considering the Miles and Snow typology, to evaluate the effects of implemented safety strategy, through authentic leadership and individual psychological capital within front line UK Offshore Oil & Gas Industry operations and the associated value chain contributors.

2.11 CHAPTER SUMMARY

This second chapter encompassed the literature review undertaken to address topics considered significant to the research conducted and in support of the established research aim and objectives. It provided the reader with a critical appraisal and synthesis of the current body of knowledge related to the research topic; provided a foundation for satisfying research questions and objectives; and facilitated the identification of gaps leading to incremental contributions to the existing safety science knowledge base.

The chapter commenced by acknowledging the near five-decade significant interest in organisational strategy as a concept relative to structure and management processes, how these aspects drive competitiveness and business success. Also, that considerable amount of research and writing has been undertaken considering the organisational dimension of accidents and incidents in the workplace. However, it was recognised that there appears to be a paucity of research within the fields of strategy and safety to develop an understanding of how strategy contributes to the capability of high-risk socio-technical organisations to function competitively and effectively within safe operating parameters. The research was solely focused on the relationship between organisational strategic typology and achievement of positive safety performance outcomes within the UK Offshore Oil & Gas Industry, given that accidents within this sector can lead to devasting consequences for individuals, the environment and for business survivability itself.

Eight key subject matter areas were the focus of critical literature review, namely: Accident Causation; Human Factors in the Workplace; Safety Influencing Capital; Culture and Climate; Leadership; Social Dynamics and Psychological Processes; Business Strategies for Industry Safety Challenges; and managing for offshore safety across the value chain. Following literature review, the data and information was synthesised as depicted in Figure 2.8 leading to the formulation and finalisation of five research questions, necessary to be answered to ensure ultimate attainment of the declared research aim and objectives. With critical literature synthesized and research questions formulated, the elements for inclusion in the subsequent data collection exercise were identified.

For the semi-structured interviews were to be utilised for [qualitative] research data collection from onshore management personnel representing the UK Offshore Oil & Gas Industry typical Exploration and Production (E&P) value chain: Operator, Contractor and Sub-contractor. The focus areas identified for inclusion in the researcher developed interview script were organisational typology identification; safety strategy construct, communication, and implementation (including Human Factors inclusion); workforce psychological capital; safety leadership; and safety climate on offshore assets. In addition to qualitative data collection, the critical literature also identified research value-added subjects for quantitative data collection through inclusion in an Offshore Workforce Safety Study. The identified topics were: authentic leadership; safety climate; and psychological capital. Each to be measured using academically respected and previously validated instruments under academic licence.

The following chapter will provide the reader with a description and critical evaluation of the theoretical perspective, methodology and methods deployed for quantitative and qualitative data collection to subsequently fulfil the aim of the research study, satisfy the research questions and to ensure delivery of a robust and thorough response to the established research objectives.

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CHAPTER 3
RESEARCH METHODOLOGY

3.0 INTRODUCTION

This chapter will provide the reader with a description and critical evaluation of the theoretical perspective, methodology and data collection methods deployed to fulfil the aim of the study to ensure a thorough response to the established research questions and objectives. The purpose was to provide a research audit trail, both intellectual and physical, to deliver trustworthiness of the research inquiry (Koch, 2006; and Carcary, 2009). The established audit trail provides a clear and comprehensive account of how the research was conducted from establishment of the aim through to reporting of findings and recommendations while, at the same time, providing a means of quality assurance for the study (Akkerman et al., 2006). The trustworthiness generated served to provide a platform for future and further topic research.

3.1 SOCIAL RESEARCH WITHIN SAFETY SCIENCE

Safety science is recognised to be a scientific discipline that can provide a means to prevent accident and incidents plus the consequential and associated losses. It has wide theoretical foundations rooted in varied disciplines, for example: engineering, leadership, management, psychology, and sociology. It is viewed as both inter-disciplinary and multi-disciplinary in nature, with diverse industrial applications (Aven 2014; Le Coze et al., 2014; Pillay, 2016). With such a broad foundation, there clearly are a plethora of methodological issues facing any prospective researcher. Considerations of epistemology, ontology, theoretical perspective, methodology and methods come to the fore, particularly what to be utilised and when? Le Coze et al. (*ibid*) view contentiousness over such considerations to be an indication of the vitality of the safety science field and the variety of ways of approaching safety research as healthy rather than a damaging prospect. Further, Le Coze (2016) advocates that diversity within safety science research should be valued, arguing that overlapping concepts, indeed hybridisations, may be key to better understanding the multi-dimensional attributes of complex sociotechnical systems.

To build-out the required [intellectual and physical] audit trail the "*Four Elements*" of social research defined by Crotty (2015) plus associated and relevant terms were used as a foundation for the research. The four elements identified to inform one another and provide a framework for research are diagrammatically represented in Figure 3.1. below:

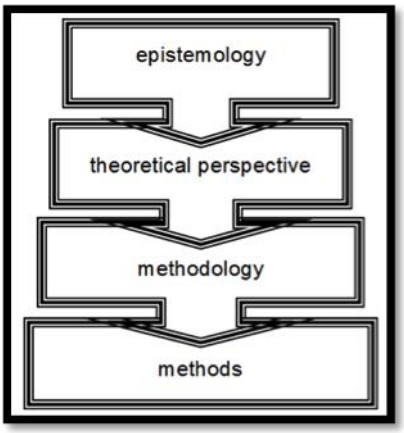

Figure 3.1: Founding Four Elements of Social Research - Crotty (2015: 4)

Crotty (*ibid*: 3) defines epistemology to be the "*theory of knowledge embedded in the theoretical perspective and thereby in the methodology*", therefore the researchers [ontological] and epistemological position underpins and influences this research study. Interestingly Albert Einstein, the eminent physicist and Nobel Prize winner, considered "*Epistemology without contact with science becomes an empty scheme, Science without epistemology is – insofar as it is thinkable at all – primitive and* muddled" (Calaprice, 2011: 429). Accepting epistemology to inform theoretical perspective, Crotty (*ibid*: 3) states the latter to be the "*philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria*". It guided the researcher to select and proceed with an appropriate methodology.

Following on, Crotty (*ibid*: 3) defines methodology to be the "*strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes*". Finally, methods are defined to be the "*techniques or procedures used to gather and analyse data related to some research questions or hypothesis*" (Crotty, *ibid*: 3). Following the four-element model for successful research, Crotty (*ibid*) unsurprisingly contends that any research activity commences

with a question that needs to be answered. Accordingly, the next section serves to restate the research aim, research questions and research objectives for the research undertaken.

3.2 RESEARCH AIMS, QUESTIONS AND OBJECTIVES

The three critical foundations of research reflected within the aim, questions and objectives served a number of crucial research purposes: they guided the critical literature review conducted; were pivotal to the research design developed; influenced the data collection process; and plus framed the data analysis conducted. Overall, they were intended to provide thesis readers with a clear sense of why the safety science research was conducted. Prior to detailing the research methodology developed it was considered instructive for readers to have the aim, questions and objectives restated.

From chapter 1, section 2.0, the research aim was established to be:

'*Explore the ways in which organisational typology, strategy, leadership, and psychological forces contribute to safety performance'*.

The subsequently generated six general focus research questions used to direct the literature review and provide the basis for research objective development, leading to greater specificity in the research to be undertaken, were defined in section 7.0, chapter 1:

1. What are the organisational typologies displayed by value chain organisations 'Operator', 'Contractor', and Sub-contractor'? The purpose of this question was to determine if there was a pattern of typology prevalent across the value chain comprising the Operator, Contractor and Cub-contractor organisations; one consistent with a credible and recognised academic model.

2. To what extent is safety strategy, with HF content, included as an aligned element of organisational business strategy for the differing organisational typologies? The second research question was developed to explore safety strategy constructs associated with identified

organisational typologies, including alignment with broader organisational strategy.

3. What is the relationship between workforce psychological capital and organisational typology within value chain organisations? The third research question was constructed to stimulate research into the ability of offshore personnel to resist the adverse dynamics of social interaction (position, power, and persuasion) that have the recognised ability to defeat safety barriers and defences in depth; evaluate whether psychological capital varies with organisational typology.

4. What is the relationship between organisational typology and safety leadership style within value chain organisations? In a manner similar to research question 3, the research question was constructed to stimulate research into effective safety leadership on offshore assets; evaluate whether safety leadership effectiveness varies with organisational typology.

5. What is the relationship between organisational typology and perceived workforce safety climate at offshore assets involved in Exploration, Operations, Asset Life Extension and Decommissioning? Considering safety climate as an indicator of safety performance this question was constructed to stimulate research into safety culture and safety climate plus consideration to variations that may be associated with different organisational typologies.

6. What effect does the Operator company safety message(s) have in creating alignment between all involved parties, irrespective of typology, to deliver acceptable safety performance? The final question was constructed with due consideration to safety messages being artefacts of safety culture. The intent was to stimulate research into safety culture alignment across the value chain representatives working on offshore assets to determine the critical influencer of safety performance, i.e. organisational typology of Operator, Contractor and Sub-contractor organisations or the Operator company's safety message.

The six established research questions were subsequently operationalised into five research objectives as defined in section 8.0 of chapter 1 to provide clear and specific statements identifying the intended accomplishments of the research undertaken:

1. To determine the extent of the influence exerted by organisational typology on the construction of safety strategy as an aligned element of overall organisational strategy. (From research question 1).

2. To establish whether the psychological forces component of Human Factors is embraced within constructed safety strategies, considering psychological capital as an antecedent of safety focused behaviour. (From research questions 2 and 3).

3. To describe the organisational typology associations with specific styles of safety leadership at the operational level on offshore assets during the lifecycle phases. (From research question 4).

4. Determine how the preceding three aspects of safety strategy implementation combine to produce individual asset safety climate profiles. (From research question 5)

5. Determine whether safety performance as reflected through safety climate perception is driven by individual organisational typologies or by the Operator company overarching safety message. (From research question 6).

Upon completion of data collection and analysis, the research aim, questions, and objectives provided a framework for data outcome discussions and formulation of data-driven conclusions: plus, guidance for the thesis write-up.

3.3 RESEARCH DESIGN

Academic research entails making connections between the mantle of fundamental assumptions from epistemological, ontological, and theoretical

positions, using them as design inputs to the methods and techniques to be utilised in the overall research process (Klockner and Pillay, 2019).

The research undertaken utilised an interpretive ontology plus the epistemology of social constructionism. Essentially, both view knowledge to be a constructed by individuals through the process of assimilation and accommodation (Dole and Sinatra, 1998; and Crotty, 2015). Young and Collin (2004) note that terms such as *'constructivism'* and *'constructionism'* are employed inconsistently and individualistically to the extent that they appear to defy definition. However, they can be distinguished; specifically, '*constructivism*' focuses on making meaning and constructing social and psychological worlds through individual cognitive process while '*constructionism*' considers that social and psychological worlds become constructed to be real through social processes and interaction. Given that a cornerstone of the current research was re-analysis of the Hopkins (2012) Deepwater Horizon accident study where it was concluded that the "*dynamics of social interaction*" contributed to the safety barrier failures (Storseth et al. (2014), the terms '*social constructionism*' and '*constructionism*' were utilised within the research study with regard to epistemology. In particular, the social constructionist paradigm enticed as being useful for exploration of emergent gaps between organisational typology, safety strategy, policy, and actual safety performance outcomes.

The philosophy adopted for this research was one of pragmatism working with variations in epistemology and ontology (Saunders et al., 2009). Pragmatism is consistent with the use of mixed methods, i.e. quantitative and qualitative, within a single research study despite the very different theoretical and philosophical assumptions. Within this research the paradigms of positivist/ post-positivist viz. scientific methods or empirical science; and interpretivist paradigms viz. socially constructed meanings, were combined to benefit the research (Petty et al., 2012).

It was necessary for the researcher to acknowledge their objective limitations as a former consultant, educator [and during the research period] a full-time employee with the Duty Holder and Operator company in the value chain under review. Grbich (2004: 4) supports the premise that the researcher

cannot be separated from their "*background, life experience and memories*". The researcher recognised that these frames of reference may filter and potentially distort their impressions of the action, behaviour, and responses of others. This was particularly relevant for a Professional Doctorate student, when attempting to empirically test assumptions drawn from professional exposure and workplace experience. Lee (2002) had reviewed the impact of the researchers' life experience on both research methodology and (to a lesser extent) the evaluation and assessment of empirical products commenting on the difficulty of suppressing and avoiding self-reflectivity. In the research undertaken it was essential for the researcher to put aside assumptions and preconceptions from previous [career] exposure to the Oil and Gas industry activities under review. Davies (2007: 9) suggested that discovering answers to questions is "*the purpose of research…the application of scientific procedures*". He appeared to refute the limitation of Lee (*ibid*) imposing a universal real-world framework, thus enabling science to exist, although he does recognise both 'experimenter' and 'experimental bias'. Having a comprehensive understanding of the processes, activities and culture being studied, the researcher was aware of the potential to unintentionally bias or prejudice the research. Acknowledging that these factors can potentially amplify the risk (Bell, 1999), the researcher did not include any operations or activities in the study where there was direct vested interest or any element of management control and influence. Nevertheless, Locke's (2001) proposition that our intellect relies, exclusively, on our senses may suggest that, unwillingly, the researcher may have been deceived through a 'research fallacy' by simply seeking to affirm an idealistic perception and employing sense data that is ontologically privileged. Coleman (1999) supports a realist epistemological approach; essentially based on a critique of positivism (but not a rejection of it). He embraced the views of Davies (2007); whilst apparently attempting to tread a compromising path between the modernist and the classical view. Coleman (1999) suggests that realist studies employ (and potentially exploit) science for 'discovery' and to study and describe hidden mechanisms and structures of reality, albeit these may be beyond our immediate experience but within our sensual perception. He explained that observational data are the manifestation of "*the workings of hidden reality and, facts are acknowledged and explained by the revelation of casual links from 'structural mechanisms*" (Coleman, 1999: 11).

Sobh and Perry (2006) argues that epistemology is the relationship between reality, ontology, and the researcher, whilst Hamlyn (1995: 242) suggests that its epistemology deals with 'the nature of knowledge, its possibility, scope and general basis'. By employing an epistemological approach, the researcher is seeking an effective way of understanding and explaining how we know what we know. It deals with the "*the nature of knowledge, its possibility, scope and general basis*" (Hamlyn 1995: 53); "*and is concerned with providing a philosophical grounding for deciding what kinds of knowledge are possible and how we can ensure that they are both adequate and legitimate*" (Maynard, 1994: 28). Bahari (2010) considers that the qualitative methods adopted in this research are typified by narratives, ethnographies, and case studies. This supported proposals that these are characterised by the development of a theory resulting from empirical data (Saunders, et al., 2009: 17). In addition, Bryman (2012) considered that qualitative research normally emphasises words rather than qualifications in the collection and analysis of data. By adopting an inductive approach, it was necessary to gather information from participants and to process and develop the information into themes, broader patterns, or generalisations. Finally, these findings are compared with personal experience and existing literature related to the topic; according to Rocco et al. (2003) this inductive logic or qualitative method is generally associated with gaining understanding of a particular phenomenon within a social context. From an epistemological point of view, the objective truth can be "*exposed because understandings and values are objectified in the people being studied*" (de Quiros et al., 2007: 2-3); extending this position, meaning is not so much discovered, but constructed given there is no 'objective truth' to be discovered. The philosophical or worldview considerations have been acknowledged, and the research design was qualified to complement this form of pragmatic investigation and social research (Grady, 1998).

3.3.1 Methodological Triangulation

A systematic research design has been identified as imperative for in-depth scholarly research, such as that required for a DBA thesis. Accordingly, the philosophy adopted for this research study was one of pragmatism working with variations in epistemology, ontology, and axiology (Saunders et al.,

2009). Pragmatism is consistent with the use of mixed methods, i.e. quantitative and qualitative, within a single research study despite the very different theoretical and philosophical assumptions. Within this research the paradigms of positivist/ post-positivist viz. scientific methods or empirical science; and interpretivist paradigms viz. socially constructed meanings, were combined to benefit the research (Petty et al., 2012). Methodological triangulation, also referred to in literature as mixed-method research (Creswell and Plano Clark, 2006), is defined as the use of two or more research methods in a single study (Boyd, 2001). Burns and Grove (2005) conclude that the use of triangulation in research can enhance its credibility. This research utilised a triangulation approach as a blend of both qualitative and quantitative methodologies. Overall, triangulation with quantitative and qualitative methods provided an indicator for convergence among multiple and different sources of information, thus forming themes or categories in the study (Cresswell and Miller, 2000).

In addition to data gathered from critical literature review, a further two methods of data collection were used in the research. Firstly, providing quantitative data for subsequent statistical analysis, an Offshore Workforce Safety Study Questionnaire comprising three credible and validated data collection instruments: Authentic Leadership Questionnaire; the Health & Safety Laboratory (HSL) Safety Climate Tool V1.0; and the Psychological Capital Questionnaire. Secondly, semi-structured interviews were conducted onshore with senior management personnel from Operator, Contractor and Sub-contractor organisations from the Operating company's value chain. The individual interviews provided in-depth qualitative information as an enhancement to the quantitative analysis conducted; results were subject to manual content analysis. Overall, triangulation with quantitative and qualitative methods provided an indicator for convergence among multiple and different sources of information, thus forming themes or categories in the study (Cresswell and Miller, 2000).

Social scientists first referred to triangulation when discussing the use of several methods to measure a single social structure or concept (Campbell and Fiske, 1959). Triangulation provided an accurate and robust means to address the established research questions by employing more than one

research method (Denzin, 1978; and Jick, 1979). Triangulation in research involves the multiple use of data sources, observers, methods, or theories, in investigations of the same phenomenon (Ammenwerth et al., 2003). The emphasis is on reducing bias by integrating theories, methods, data sources and researchers with complementary strengths and non-overlapping weaknesses. Wilkinson (2007: 631) considers that "*multiple snapshots, even if some are not totally in focus, give a better picture than one poorly aimed photograph*". Jick (*ibid*) considered the justification for method triangulation was through enhancement of the validity of research findings and a reduction in experimental bias. Denzin (*ibid*) expanded its scope to pertain to the whole research design, considering that triangulation helps to avoid the error factor implicitly present in research based on a single method, a single researcher, a single observer, or a single theory analogously to the logic of navigation. Boyd (2001) provided the essential motivation behind the use of triangulation is the enhancement of validity of qualitative research through the confirmation of findings from two or more data-collection methods.

Triangulation approaches can be differentiated (Fotheringham, 2010): theoretical (or method) triangulation; data triangulation; and investigator triangulation. Method triangulation has been used in research either to confirm the concept under study or to capture the completeness of the phenomenon under study (Cresswell et al., 2003). It has also been proposed that studies with a multiple-method approach can, either intentionally or unintentionally, represent both the effort to confirm validity and the aim to capture the holistic completeness of the phenomenon (Coyle and Williams, 2000; and Risjord et al., 2002). Method triangulation can be sub-divided into two categories: within-methods; and between-methods.

Triangulation within-methods utilises multiple techniques within a given method to collect and interpret data. For example, multiple indices focused on the same construct within (quantitative) survey research and multiple comparison groups for (qualitative) observational studies. Triangulation between methods, on the other hand, refers to the combination of a quantitative and a qualitative method in the same study which means that data are collected about the phenomenon under study by means of interviews, observations, inquiries, or document analysis (Denzin, 1978; and

Cresswell et al., 2003). According to Jick (1979: 603) "*within-method triangulation essentially involves cross-checking for internal consistency or reliability while between-method triangulation tests the degree of external validity*". External validity was considered an essential element of the research. Denzin (*ibid*) is dismissive of the within-method approach and holds the opinion that between-methods triangulation reaps the benefits of each method while also compensating for their weaknesses. This position was considered pivotal to the research and has been used as an input to the methodology framework. Boyd (2001) considers that when the purpose of triangulation is completeness it may contribute towards the comprehensive nature of a study. Completeness was considered an essential feature in answering the research questions. Finally, triangulation was adopted for this research to reduce sources of error and to increase the validity and reliability of the findings. This approach is consistent with the view held by Bryman (2012: 635) where within triangulation "*the results of an investigation employing a method associated with one research strategy are cross checked against the results of using a method associated with the other research strategy*". These considerations led to the between methods approach being adopted as most appropriate for the safety science research undertaken.

3.4 RESEARCH DATA POPULATION

Research data was collected from two distinct sample populations from within an Operator company's value chain. The research data population was considered representative of the typical UK Offshore Oil & Gas Industry value chain and therefore determined to be valid. The Operator company that granted permission for the research was one of the world's largest independent Exploration & Production company based on production and proved reserves. Headquartered in Houston, Texas, the company had operations and activities in 17 countries, $69 billion of total assets, and approximately 11,200 employees as of June 30, 2018. The annual production average during 2018 was 1,216 MBOED and its proved reserves were 5.0 billion BOE. The Operator was an archetypal International Oil Company with competitors similar in nature operating in the UK Offshore Oil & Gas Industry. Adding to the data population representativeness and validity, all Operators active within the UK must follow the same safety governance and legislative

requirements. Also, many of the Contractor and Sub-contractor organisations working for the Operator organisation engaged in the safety science research frequently (and simultaneously) work with the other Operator companies active within the UK Offshore Oil & Gas Industry.

Qualitative data pertaining to organisational strategic typology factors influencing safety performance outcomes was collected through purposive semi-structured interviews conducted onshore. The individuals interviewed were representatives from middle and senior management from Operator, Contractor and Sub-contractor organisations; all had personnel working on offshore assets working for or on behalf of the Operator. A total of 39 personnel submitted for semi-structured interview: 16 (41%) were from the Operator company; 14 (36%) were representatives of Contractor organisations; and 9 (23%) were Sub-contractor personnel. The interviews were conducted between June 2018 and March 2019.

Quantitative data pertaining to Leadership, Safety Climate and Psychological Capital was collected from seven separate offshore assets engaged in the full scope of the Operator's value chain activities: drilling and exploration; hydrocarbon production; asset life extension; well plug and abandonment; and decommissioning. The seven assets sampled were diverse in nature and the total research population presented during data collection was 755-persons maximum on any one given day. To accommodate for personnel movements and variations in shift patterns, a total of 1000 data collection questionnaires were administered across the assets between October 2018 and March 2019. A brief outline of individual asset functionality is provided.

Situated approximately 70 miles east of the Lincolnshire coast Asset A1 was originally brought onstream during 1988 with further upgrades during 1993 and 2011. It consisted of a single gas gathering complex developed to collect gas from a total of sixteen satellite platforms and six subsea centres distributed up to a maximum distance of 20-miles from the main complex within the UK's Southern North Sea (SNS) sector. The asset comprises of five jackets linked together by fixed bridges, each jacket with a specific operating function: Personnel Accommodation; Wellhead; Main Gas Riser; Production; and Gas Compression. Produced gas from the complex was subsequently

exported via a 36-inch pipeline to an onshore Gas Terminal prior to entry into the UK National Grid. Maximum Personnel Onboard (POB) at the time of research was limited to 103 persons in accordance with the Regulatory approved Safety Case. At the time of research, the Operating Company held 25% to 61.1% in the field operations (including satellite platforms and subsea centres) along with a further five Field Partners each with holdings of between 15% and 75%. Field Partners have influence over commercial aspects of oil and gas production. They do not influence safety outcomes through day-to-day control of work arrangements. During August 2018 while the research project was being undertaken, total field production was terminated by the Operating Company and the asset entered a Decommissioning phase. Wells were to be plugged and abandoned, platform topsides to be cleaned and drained for hydrocarbon free status, then the Asset (jacket and topsides) prepared for eventual physical removal within a maximum four-year period based on structural engineering assessments. Asset A1 was in a Warm Suspended, Live Wells and Manned status when the research was conducted.

Situated approximately 112 miles north east of the Lincolnshire coast, Asset A2 was originally brought onstream during 1993, with subsequent expansions during 1996 and 2002. Like Asset A1, it was a single gas gathering complex, collecting gas from eight satellite platforms and seven subsea centres within the SNS. The asset comprises of three bridge linked jackets, each with specific operating functions: Wellheads; Risers; Separation; Compression; and Accommodation. Produced gas from the complex was subsequently exported via a 26-inch pipeline to an onshore Gas Terminal prior to entry into the UK National Grid. Maximum POB during the asset's operating phase was 37 persons in accordance with the approved Safety Case, with an increase to 103 persons for Decommissioning. At the time of research, the Operating Company held 39% to 59.5% in the field operations (including satellite platforms and subsea centres) along with a further three Field Partners each with holdings of between 9.5% and 44.5%. At the time of research, the Asset was progressing through the phases of Decommissioning, i.e. well plugging and abandonment, topsides cleaning and hydrocarbon freeing, with preparation for eventual removal. A2 was in a Warm Suspended, Live Wells and Manned status with a projected Cold Suspension-Unmanned timeline for Spring 2020.

Asset A3 was situated approximately 150 miles south east of Aberdeen and comprises of a Wellhead Platform and a bridge-linked Accommodation and Utility Platform. Field production commenced during 2013 and at the time of research POB was restricted to 38 persons in accordance with the approved safety case. Hydrocarbons (gas and oil) extracted at Asset A3 are exported along an approximately five-mile multiphase export pipeline to Asset A4 for subsequent processing and onward distribution. At the time of research and in addition to the Operating Company equity of 36.5%, there were two Field Partners with 33% and 30.5% interest in Asset A3. Additionally, while the research was ongoing, Asset A7 was conducting exploration and drilling activities alongside Asset A3 in Combined Operations where drilling activities were conducted simultaneously with hydrocarbon production operations. This presented an additional suite of [potential but recognised] hazards to be effectively managed by the Operating Company.

Asset A4 was located approximately 150 miles East of Aberdeen commenced hydrocarbon (oil and gas) production during 1997. Production facilities include: a 24-slot well bay; hydrocarbon separation; gas compression; power generation; and personnel accommodation. The Asset processes hydrocarbons received from Asset A3, a further subsea development plus a normally unattended satellite. Subject to periodic upgrade, permissible POB in accordance with the approved Safety Case has risen from the originally approved 50 up to 103 by the time of research. Produced gas from the Asset is shipped through the Central Area Transmission System Pipeline (CATS) for processing at Teesside; produced liquids are also transported to Teesside through the Norpipe System, both critical pieces of UK infrastructure. In addition to the Operator (36.5%) there were two Field Partners with 33% and 30.5% interest in Asset A4 Asset at the time of research.

Situated approximately 130-miles north east of Aberdeen, Asset A4 commenced production operations during 1998. The Asset incorporates accommodation, utilities, gas and associated liquids processing, compression, metering, export and drilling facilities. It processes hydrocarbons from a total of six different fields in an adjacent 26-mile radius. POB at the time of research was 168, the largest of any asset included in the data sampling exercise. Hydrocarbon gas condensate is exported through the Forties Pipeline to an oil stabilisation and processing plant, Kerse of Kinneil, near the

Grangemouth Refinery in Scotland. Natural gas is transported through a dedicated pipeline to the Scottish Area Gas Evacuation (SAGE) facility at St. Fergus, Scotland. In addition to the Operator (36.5%) there were two Field Partners with 32.3% and 9% interest in Asset A5 at the time of research.

Asset A6 was Jackup Drilling Rig with a maximum POB capacity of 90 in accordance with its approved Safety Case. At the time of research, it was engaged in well plug and abandonment activities at a normally un-manned satellite facility within the Operating Company's SNS portfolio. It was also hosting teams conducting associated decommissioning activities required to facilitate Cold Suspension status and preparations for final dismantlement and removal. Asset A6 had been used exclusively by the Operating Company for this specific purpose during the previous four years. The operation was being conducted under a Bridging Document that comprehensively described the organisational interfaces between the Operating and Drilling companies, along with the safety management control of work arrangements, and governance for the operations being undertaken.

Asset A7 was also a Jackup Drilling Rig with a maximum POB capacity of 150 in accordance with its approved Safety Case. At the time of research, it was engaged in combined operations with Asset A3, drilling several development and exploration wells and had been on location for approximately one year. Mirroring Asset A6, the work was being undertaken in accordance with an approved Bridging Document.

3.5 DATA COLLECTION TOOLS

3.5.1 Semi-Structured Interviews

Individual interviews, although time consuming, were selected as a qualitative method for obtaining in-depth information to illuminate the relationship between organisational typology, safety strategy and safety performance. The thematic semi-structured interview as a qualitative research tool was adopted in compliance with a pragmatic view that research must add value and be unequivocally useful to both the researcher and audience of the findings (Glaser and Strauss, 1967). This element of the

research was guided by the methodological tenets (and tools) described by Denzin and Lincoln (2000: 14) who stated that "*the topics and concepts must be appropriate and relevant to the concept of the study*". The semi-structured interview themes were developed from the research aim and objectives and an interview schedule of the topics and questions to be addressed was used (see Appendix 1). The researcher had some discretion about the order in which questions were asked, but the questions were standardised, and all were asked. This interview method was chosen since it enabled the collection of detailed information in a conversational style (Harrell and Bradley, 2009). The semi-structured the interviews did not deviate from the subject matter permitting some opportunity for the interviewee to expose their views. The assured confidentiality encouraged the interviewees to express opinions and beliefs; when an interviewee proved knowledgeable or exposed a strong opinion on specific topics, this was explored. Interviews were recorded with the interviewee's permission and transcribed for subsequent content analysis.

Researchers have advocated guidelines for qualitative sample sizes. Charmaz (2006: 114) for example suggests that "*25 (participants are) adequate for smaller projects*"; according to Ritchie et al. (2003: 84) qualitative samples often "*lie under 50*"; while Green and Thorgood (2009 [2004]: 120) state that "*the experience of most qualitative researchers (emphasis added) is that in interview studies little that is 'new' comes out of transcripts after you have interviewed 20 or so people*". For this research, a purposive sampling method was used. It was necessary to generate sufficient good quality data to illuminate patterns, concepts, categories, properties, associations, and dimensions (Thomson, 2011). In this respect an appropriate sample size was established (Auerbach and Silverstein, 2003) achieving theoretical saturation (Glaser, 1992) and delivering data with a reasonably rigorous claim to true representation. Considering Green and Thorgood (*ibid*) this was established as 45 representatives from middle to senior management from across the Operator company's value chain. Theoretical saturation was to be recognised when further interview data yielded no additional information; no relevant data became emergent with regard to determined content analysis (CA) categories; and the relationship amongst (and between) categories had been established and validated (Strauss and Corbin, 1998).

3.5.2 Offshore Workforce Safety Study Questionnaire

During the timeframe granted for offshore research and data collection one study questionnaire was administered that combined four separate measurement tools: Authentic Leadership; Safety Climate; and Psychological Capital. To maximize respondents, the questionnaires were provided to 100% of the seven offshore assets population (755) with some additional questionnaires to capture rotational personnel change-outs. A total of 1000 questionnaires were issued offshore. Due to computer and internet access limitations for personnel working offshore, data collection was manual; no electronic survey tool, e.g. SurveyMonkey® or Zoomerang® was utilised. The Study was facilitated by the individual asset Safety Advisor's at weekly Safety Meetings with voluntary participation requested. The Questionnaire was designed to take approximately twenty minutes to complete and there was an opportunity provided for respondents to provide additional comments about leadership, safety climate, safety performance, and/or other safety matters on their asset. Additionally, respondents were requested to comment on Questionnaire ease of use across a 5-point scale from easy to difficult. The request to return uncompleted Questionnaire documents was fully complied with. The three components of the Study Questionnaire are described below.

Part One, the Authentic Leadership Questionnaire (ALQ) used under Academic Licence for the research project was developed by Avolio et al. (2008) as a theory-based measurement tool to quantify the four dimensions of authentic leadership: self-awareness; relational transparency; internalized moral perspective, and balanced processing. Previous testing has demonstrated satisfactory validity (Luthans et al., 2007) however Caza et al. (2010) determined a sizable positive correlation between the constructs of psychological capital and authentic leadership where it had been theorised (Gardner and Schermerhorn, 2004) that authentic leaders will increase their followers' psychological capital. Prior to the Caza et al. (*ibid*) study there has been no empirical test of such a predicted relationship (Luthans and Avolio, 2009). The ALQ had two component elements, 'Self' and 'Your Leader'. Respondents were asked to rate their Leader's style. If the respondents led teams of two or more persons, they were requested to rate their own leadership style. In both cases, respondents were requested to report the

frequency on a 0 to 4 Likert Scale (from 'not at all' to 'frequently if not always') with which they (or their supervisors) adopted the 16 behaviours/attitudes specified. The Academic Licence and permission for use was granted on 31st August 2018 and did\ not permit inclusion of the research instrument and question set in the produced thesis.

Part Two, the Safety Climate Assessment Tool (SCT) used under Academic License for research had been developed by the Health and Safety Laboratory (HSL), and as such was regarded as a reliable and valid psychometric tool. Conditions of the Academic Licence (granted 29th November 2018) prevents publication of the SCT question set. The SCT was first published by the Health and Safety Executive in December 1997 before being withdrawn during early 2007 and subsequently revised (Sugden et al., 2009). The questionnaire has been designed for respondents to rate their responses to statements on a 1 to 5-point summated rating (Likert) scale from strongly disagree to strongly agree. A measurement tool utilising a Likert scale was selected for research purposes ahead of other measures, e.g. Thurstone scale, Guttman scale, Q-sorting or semantic differential scales (Robson, 2011) primarily because of familiarity of use within the offshore workforce. Ten Klooster et al. (2008) note that Likert scaling is a well-accepted technique for attitude measurement. They also consider that, mainly due to simplicity and reliability, Likert scales have gained in popularity over other measurement scales as research instruments. The SCT had been purposely designed to seek the views of all levels of the workforce so that their results can be compared. Some statements are inverted so as not to 'lead' respondents towards one particular point of view. For example, '*People here are sometimes pressured to work unsafely by their work mates*' and '*Management only bother to look at health and safety after there has been an accident'*. The survey comprises of 40 statements that map onto eight safety climate attributes; it is written in clear English and leading and/or ambiguous items were removed during the 2007 revision process. The SCT is a survey tool designed to capture workers', supervisors' and managers' perceptions of health and safety issues thereby providing an insight into the safety culture present within an organisation (Healey and Sugden, 2012). Use of the SCT may also provide a within-organisation benchmarking opportunity, leading to increased motivation for safety practitioners involved in controlling risks (Mearns et al.,

2001). Further, the SCT was successfully validated for offshore Oil and Gas industry use during earlier research (Spence, 2013).

Part 3, the Psychological Capital Questionnaire, used under Academic Licence was developed by Luthans et al. (2007). It is regarded as a valuable tool for predicting performance in the workplace (Luthans et al., 2010), workforce satisfaction (Luthans, Avolio, Avey and Norman, 2007; Luthans, Norman, Avolio and Avey, 2008), in-role performance (Gooty et al., 2009), as well as organisational commitment (Luthans et al., 2008). The concept of PsyCap draws extensively from the positive psychology movement with the questionnaire being constructed from four scales (self-efficacy, hope, resiliency, and optimism) as a means of supporting investment in people to create competitive advantage (Youseff, 2004). The construct has firm roots in positive psychology, focusing on a positive approach to managing human resources in modern workplaces (Luthans et al., 2007). Eid et al. (2012) considered PsyCap to have the potential to mediate the relationship between authentic leadership and safety climate within safety critical organisations, such as offshore oil and gas assets, where personnel must regularly adapt to a fast-paced, hazardous, sometimes-unpredictable, and frequently hostile environment. The PsyCap Questionnaire was developed from measures widely recognized and published in academic literature and has twenty-four items, six for each of the four dimensions (hope, optimism, self-efficacy, and resilience), to which respondents should indicate their level of agreement using a 1 to 6-point Likert scale (from 'strongly disagree' to 'strongly agree'). Similar in nature to the SCT, the PsyCap Questionnaire also contains some inverted items. Given that Eid et al. (2012) contended that PsyCap may represent a more positive motivational state thereby promoting an increased level of safety behaviour and associated practice plus Bergheim et al. (2015) concluded that PsyCap would be a desirable and an interesting construct to include in future research on safety related matters, the 24-Point PsyCap Questionnaire was included as an element of the Offshore Workforce Safety Study. Scoring for PsyCap is purely total points but may be broken down into the constituent elements of Hope, Efficacy, Resilience and Optimism. The Academic Licence and permission for use was granted on 31st August 2018 and did not permit inclusion of the research instrument and question set in the produced thesis.

All three data collection tools utilised were unaltered for the purposes of the research undertaken to ensure there was no detrimental impact upon assessed construct reliability and validity. The Terms of signed Academic Licenses plus associated Confidentiality Agreements prevented reproduction of the entire data collection instruments in the final written thesis. Inclusion of three sample items from both the ALQ and PCQ were authorised. Zero inclusion of sample items was granted for the academic use of the SCT.

The Offshore Workforce Safety Study Questionnaire was initially piloted with a group of Safety Practitioner colleagues and known persons with Offshore working experience. This relatively small group of volunteers reflected and were comparable to members of the eventual Asset research population. The purpose was to refine the Questionnaire to ensure that offshore-based respondent difficulty in answering questions and recording data was reduced to as low as reasonably practicable (Saunders et al., 2009). Further, piloting provided an opportunity to ensure that the compiled research instrument functioned effectively (Bryman, 2012) and provided viable data. Given that the developed research instrument was a self-completion questionnaire, piloting provided an opportunity to avoid considerable wastage before questionnaire problems for respondents became manifest; particularly essential since the Researcher would not be present when the Questionnaires were administered across the seven individual Assets providing the research population. Variants of the Questionnaire were trialled with: different ordering of the three data gathering components (SCT, ALQ, and PCQ); short and long versions of the PCQ Self-Rating questionnaire; plus inclusion or omission of the PCQ Other-Rating questionnaire. None of the piloting activity was conducted with personnel that would [eventually] form part of the formal research study population.

An abbreviated version of the Offshore Workforce Safety Study is contained in Appendix 4; question sets were not included to maintain compliance with the Academic Licence terms and conditions.

3.6 CONTENT ANALYSIS

Content Analysis (CA) was employed to systematically examine the interview transcribed material. CA is a research method that provides a systematic and objective means to make valid inferences from verbal, visual, or written data to describe and quantify specific phenomena.

As with any research strategy, the objective of content analysis is to provide knowledge and understanding of the phenomena under study (Downe-Wamboldt, 1992). Hsieh and Shannon (2005: 1278) define qualitative content analysis as "*a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns*". The semi-structured interview transcripts were subjected to conceptual CA. In conceptual analysis (known also as thematic analysis) the text is scrutinized to check the existence and frequency of a concept/theme (Krippendorf, 2004). In this method, dominant concepts/themes in the text were categorized into codes (Franzosi, 2007). Instead of counting the frequency of word usage as used in word-based content analysis, the approach attempted to find similar cognitions under the same concept (Swan, 1997). The underlying principle was to identify the occurrence of selected terms within the text. These terms can be implicitly or explicitly related to the concepts/themes under consideration (Colorado State University, 2009). Even though identifying the explicit terms was straightforward, capturing the implicit terms related to a concept/theme had to be done with care. Since the latter is based on the judgments of the researcher, it may affect the reliability and validity of the data. As such, the development of a good conceptual/thematic analysis required the researcher to be familiar with the text and pretesting of the codes (Franzosi, 2007) to clearly define the implicit terms before starting the data analysis process (Colorado State University, 2009).

Although a relatively time-consuming process CA provides, as stated by Moretti et al. (2011: 427), an example "*of how qualitative data analysed in a systematic way can be able to balance the richness of data obtainable from qualitative methodologies with the scientific rigour of quantitative*

approaches". For this reason, CA was considered an important element of the methodological triangulation approach adopted for the research.

Interview transcripts were reviewed for identification of organisational typology plus the presence of safety strategy (documentation, HF content, communication, and execution). Transcripts were also reviewed for content reflecting the dynamics of social interaction leading to inaccurate hazard identification, represented by the phrases: consensus mode decision making; confirmation bias; warnings normalisation; and group think. Evidence of pressure by management and supervision to place productivity before safety performance was evaluated by phrases relating to the imposition of: position; power; and pressure. Similarly, evidence of psychological capital was searched for with phrases relating to people characteristics: hope; efficacy/confidence; resilience; and optimism. Finally, authentic leadership traits were sought through terms reflecting: safety culture/climate promoting; engaging; motivational; committed; and involved.

3.7 STATISTICAL ANALYSIS

There are certain types of data where the meaning may not be immediately evident when presented in statistical, text or tabular formats. As the number of variables increases, in this case ALQ, SCT, and PCQ factors, there may be a commensurate challenge to describe their meaning (Saary, 2008). To overcome this, Radar Plots (MS Excel™) were used to display and compare ALQ, SCT and PCQ scores for the Asset workforces. Radar Plots provided a clear summary of complex data; Stafoggia et al., (2011: 777) noted that, as a management tool, such a graphical method may "*facilitate the setting of priorities for improvements, resource allocation as well as accountabilities*".

The data collected from the instruments and scales of the Offshore Worker Safety Study was analysed utilising non-parametric techniques since the data was measured on and produced from ordinal (ranked) scales. Distinct from parametric techniques, the non-parametric techniques make no assumptions about underlying population distribution from which the data sample has been drawn. Consequently, non-parametric techniques may have disadvantages through reduced sensitivity and in some circumstances fail to detect

differences in data groups that does exist. There are key assumptions for non-parametric data analysis techniques to be necessarily checked. Firstly, that the samples are completely random. Secondly that observations are independent; each person (or case) can be counted only once and not appear in more than one group; the data from one subject must not influence the data from another. The IBM® SPSS® Statistics (Version 26) package was utilised to conduct a range of analysis of ALQ, SCT and PCQ data obtained. From SPSS®, the Mann-Whitney U Test was utilised to test for differences between two independent groups on a continuous measure. It is the non-parametric alternative to the t-test for independent samples. Whereas the t-test compares the mean of the two groups, the Mann-Whitney U Test compares medians; it converts the scores on the continuous variable to ranks across the two groups and then evaluates whether the ranks for the two groups differ significantly. Given the scores are converted to ranks, the actual distribution of the scores ceases to be relevant. The Kruskal-Wallis Test (alternatively referred to as the Kruskal-Wallis H Test) as a non-parametric alternative to a one-way between-groups analysis of variance was also utilised. Similar in nature to the Mann-Whitney U Test, it permits comparison of scores on a continuous variable for more than just two groups. In the test, scores become converted to ranks and the mean rank for each group gets compared. Given that test is a between groups analysis, different people must be in each of the different groups.

Finally, correlation analysis was conducted to evaluate the strength and direction of the linear relationship between two continuous variables (SCT - ALQ, SCT - PCQ, and ALQ – PCQ). Given that the data being analysed was obtained from ordinal (ranked) scales the SPSS® technique selected and utilised was the Spearman Rank Order Correlation (rho), the non-parametric alternative to the ([parametric] Pearson correlation.

3.8 LIMITATIONS

At the outset of research, the intention was to collect data from multiple operating organisations within the UK Offshore Oil & Gas Industry, utilising a working relationship previously established with an industry representative body comprised of different stakeholders from across the industry. Following

a 2018 change in [senior] personnel the opportunity for intended data collection necessitated revision and subsequently the research study was conducted within the confines of a single UK Offshore Oil & Gas Industry operating company. This unforeseen change delayed data collection by approximately six to nine months given that research approval had to be negotiated with an Operator organisation. Consequently, the modified approach resulted in data collection and benchmarking from one Operator organisations value chain, hence a potential limitation. However, the operating company researched was one of the largest Exploration & Production (E&P) organisations operating the UK Industry with a complex and industry-representative value chain, the data collection opportunities were considered [and agreed by the researcher's Supervisory Team] to be rich. Further, many of the Contractor and Sub-contractor organisations associated with the Operator worked for many other E&P organisations operating within the UK Oil & Gas Industry. For these reasons, the potential for reduced external validity of the research (Saunders et al., 2009: 158) became eliminated.

No inhibits or restrictions to accessing organisational data and personnel were identified, provided that the Operator, Contractor and Sub-contractor organisational confidentiality was maintained through the thesis publication. The ALQ, SCT and PCQ data collection tools were used in accordance with the terms of the Academic Licences granted. As such, confidentiality of the question sets was, in all three cases, a Licence condition prohibiting publication of a thesis containing the original question sets in any public domain to prevent plagiarism of copyrighted material.

A potential limiting factor with the triangulation methodology utilised was the potential for difficulty during attempts to fully to synthesise the data accruing from qualitative and quantitative methods. Sim and Sharp (1998) noted this to be a likely possibility when assumptions underlying the different approaches to data collection, for example, questionnaires and individual interviews, may differ so greatly as to prevent any meaningful combination or comparison of the data obtained by each.

As previously stated, data collection for the Offshore Workforce Safety Study was conducted manually due to computer and internet access limitations for personnel working offshore. As a direct consequence, data was manually transcribed prior to subsequent analysis. Manual transcription of numerical and written data is known to be prone to error, notably omissions, illegibility, and numerical error (Kawado et al., 2003: Black et al., 2004: Kozak et al., 2015). Such data entry errors introduce a source of random error into research findings that have the potential to distort statistical results and detrimentally impact research conclusions. (Barchard and Verenikina, 2013). As a minimum, such errors reduce reliability, effect sizes, and statistical power, making significant findings less likely. In extreme cases, they can invalidate a statistical analysis. There are two common methods used for prevention of data entry errors, double entry, and visual checking (Barchard and Pace, 2011). Typically, for double entry with mis-match checking, the researcher enters the data twice. A computer program subsequently compares the entries to identify mismatches. Where mismatches are identified, the researcher is prompted to the original data recording to determine the correct value. With a visual checking approach, the researcher enters the data once directly into a spreadsheet or a statistical package then visually compared the data entered against the original and raw data recording; errors corrected when found. Both the Kawado et al. (*ibid*) and Barchard and Pace (*ibid*) studies concluded that the double entry approach was significantly more effective in entry error detection than visual checking. However, Johnson et al. (2009) concluded that double entry was not necessary for transcription of data where extensive logical checks can be utilised. For the current research, a visual checking approach was adopted by the researcher. Data from the Offshore Worker Safety Survey was numeric in its entirety, separated into four discrete sections; there was no interpretive component or word transcription required. The logical checks adopted were in the form of Hold Points at the end of each section for the entered data to be checked against the raw data record. This was supplemented by a ten percent sample check for transcription accuracy performed by a person independent from the research project.

For Content Analysis, the validity of the deduced outcome may be questioned due to possible subjectivity through selective questioning and intervention,

categorisation, and interpretation. Attempting to reduce researcher induced bias, the categories produced by the researcher were validated by an independent HSE Professional.

Social desirability, with individuals reporting inaccurately on sensitive topics to present themselves in the best possible light, may have affected the results of both the semi-structured interviews and the Offshore Workforce Safety Study despite the assurances provided of anonymity and confidentiality. Consideration for any future research may be given to controlling such bias by using, for example, the Marlowe-Crown Social Desirability Scale or Paulhus's balanced Inventory of Desirable Responding (Leite and Beretvas, 2005).

3.9 ETHICS

The research was carried out strictly in accordance with the current Robert Gordon University Research Ethics Policy. As required, a Student Proposal Ethical Review (SPER) Form was originally submitted (29th January 2016) to the Research Supervisor. The Form was regularly reviewed during the research project with no alterations required.

The research was designed and undertaken consistently and fairly to preserve the honesty, integrity, and quality of the findings. All participation was undertaken on a voluntary basis and the research was undertaken openly. Strict confidentiality was assured to all respondents and interviewee's and this has been preserved throughout the research by the exclusive employment of nominal codes, with limited descriptive data to identify respondents and interviewees. Prior to any request for interview, subjects were provided with a research information sheet (Appendix 2) that included an invitation to sign for interview consent.

3.10 CHAPTER SUMMARY

This chapter defined for the reader all four elements of social research underpinning the research project, namely the epistemology, theoretical perspective, methodology and methods. These four elements were critical to

building-out the necessary [intellectual and physical] audit trail thus providing a clear and comprehensive account of how the research was conducted from establishment of the aim, objective and research questions through to reporting of findings and recommendations; all within a quality assured research study. A methodological triangulation approach was selected for research with the philosophy adopted for this research study being one of pragmatism working with variations in epistemology, ontology, and axiology. The sample population was described for both onshore and offshore data collection exercises. In addition to data gathered from critical literature review, a further two methods of data collection were to be used in the research: semi-structured interviews with senior management personnel from Operator, Contractor and Sub-contractor organisations; and the administration of an Offshore Workforce Safety Study Questionnaire comprising three credible and validated data collection instruments. Qualitative data gathered from semi-structured interview was to be subject to manual content analysis. Quantitative data produced from the ordinal (ranked) scales contained in the Safety Study was to be analysed utilising non-parametric statistical techniques.

The limitations to this operational research (Saunders, Lewis and Thornhill, 2003) are acknowledged and the researcher has endeavoured to counter a number of the associated risks, by adopting a 'systematic approach' and employing a transparent research process, trusting that this supports the basis of enquiry and that the research findings became based upon a logical relationship and not just 'supposition' or belief (Ghauri and Gronhaug, 2010). The richness of data collection potential from a single operating company within the UK Offshore Oil & Gas Industry was not considered to be a limitation, given the typical nature of the operators' value chain and that involved Contractor and Sub-contractor organisation also worked for other industry Operating companies.

It would have been unsafe for the research to have been exclusively reliant upon the researcher's professional experience within the Oil and Gas Industry. The experience may have served to inform the primary research findings by supporting context placement and narrative interpretation, but in isolation, it did not form the basis of argument or proposition. In accordance

with the advice of Stake (1995: 240), the "*researcher aspired to objectivity, giving proper regard to validity and reliability being provided with this salutary reminder that criteria of representation ultimately are decided by the researcher*". Thus, an interpretive approach to the research was adopted, acknowledging the researcher's intimate relationship with the subject under review together with the "*situational constraints shaping this process*" (Rowlands, 2005: 81). The interpretive research did not seek to predefine variables, nor test hypothesis, rather it aimed to produce an "*understanding of the social context the phenomenon and the process whereby the phenomenon influences and is influenced by the social context*" Rowlands, *ibid*: 81-82).

Finally, the ethical considerations of research were considered with acknowledgement that the research had been conducted strictly in accordance with the Robert Gordon University Research Ethics Policy.

The following chapter will present to the reader data findings generated from the qualitative and qualitative data collected through semi-structured interviews plus application of the Offshore Workforce Safety Study (ALQ, SCT and PCQ).

*** *** ***

CHAPTER 4
RESEARCH FINDINGS

4.0 INTRODUCTION

This chapter will, for the reader, detail the qualitative and quantitative data findings obtained from the adopted pragmatic research philosophy and through the established triangulation methodology, sometimes known as mixed method research. The results and outcomes from conducted content analysis on qualitative data, plus non-parametric statistical analysis of collected quantitative data, will be presented in detail with conclusions drawn where possible. The information generated will subsequently be utilised in the following chapter to discuss and relate the data findings to the established research aims, questions, and objectives previously defined in Chapter 1.

4.1 QUALITATIVE DATA

Qualitative data was collected through semi-structured interviews for which an interview schedule was developed (Appendix 1). The schedule was itemised to support subsequent evaluation and analysis. This was in accordance with Kumar's (2005) recommendations that differentiate between the structured schedule as a qualitative research tool, and the interview itself which is recognised a method of data collection. This provided some advantage in that it delivered comparably "*uniform responses which assures the comparability of data*" (Kumar, 2005: 126). The semi-structured interviews were conducted amongst onshore management and senior management personnel associated with the assets where the Offshore Safety Study had been administered. Table 4.1 illustrates a summary of the interview subjects by value chain role and occupation. Interviewees were selected based of their roles, with the pre-existing knowledge that a focus on safety was central to the discipline and function; purposive sampling was employed to ensure the range of interviewees were drawn from across the Operators value chain. A strident attempt was made to achieve a-near equal balance between Operator, Contractor and Sub-contractor. This ultimately proved more difficult with Sub-contractor interviewee's who, for a variety of

reasons, frequently pulled-out of arranged interviews at late and short notice. Their under-representation may be considered a limitation to the research

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Value Chain Role	Senior Manager	Operations Manager	HSE Manager	Engineering Manager	HSE Auditor	TOTAL	% of Total
Operator	3	4	4	3	2	16	41%
Contractor	3	3	4	2	2	14	36%
Sub-contractor	5	1	2		1	9	23%

Table 4.1 Interview respondents by value chain status and role

Consent was provided for all interviews to be recorded; all interviewees gave the Researcher permission to follow-up with them in the event there were points of uncertainty from transcript creation. Subsequently, each interview recording was sent to an online service provider for transcription and subsequently returned as a downloadable Microsoft Word™ file. The process of transcription resulted in approximately 350 pages of transcript. Each transcript was reviewed, compared, and contrasted with the recorded interview file. Responses were tabulated onto a spreadsheet to enable manual content analysis of the data. The Researcher made a conscious decision conduct a manual content analysis rather than to use a software package thus remaining as close to the raw data content as possible. This was consistent with the process undertaken for the quantitative data where all Offshore Safety Survey questionnaires were processed manually prior to statistical analysis. The process of manual handling ensured immersion within the data, provided additional insight, and highlighted [potential] trends in the returned Survey responses. According to, de Graaf and van der Vossen (2013) both manual and automated methods of content analysis have advantages and disadvantages. It has been considered that automated methods may have different but persistent types of reliability problems. Also, for smaller samples such as the safety science research undertaken, manual methods can even be more efficient and effective than automated methods. A common experience previously observed was that automated methods do not lead to efficiency gains when working with small datasets (Matthes and Kohring, 2008). Also, due to the high time investment required to prepare data for analysis automated methods are typically more efficient for large samples (de Graff and van der Vossen, *ibid*). The completed spreadsheet of

interview responses was subsequently reviewed for common themes in response to the investigation points, each linked to a Research Question. Organisational typology across the three work groups was expressed as a perception percentage. Recognition of the research topics during interview are summarised P1 to P3, where P1 indicates comprehensive target phrase inclusion or subject recognition, P2 being partial, and P3 representing absence. Table 4.2 provides a summary with high-level narrative.

	Operator	Contractor	Sub-contractor
IPO1 - Typology (Research Objective 1)	-	-	-
IP01-1: Defender	76%	13%	
IP01-2: Defender/Prospector	24%	13%	
IP01-3: Prospector		74%	
IP01-4: Prospector/Analyzer			
IP01-5: Analyzer			58%
IP01-6: Analyzer/Reactor			15%
IP01-7: Reactor			27%
IPO2 - Safety Strategy (Research Objective 2)	P2	P2	P2 – P3
IP02-1: Clearly defined?	Expressed through goals, objectives, policy, and procedure	Sometimes expressed through goals, objectives, policy, and procedure	Variable to none
IP02-2: Included in Business Scorecard?	High level lagging metrics only	High level lagging metrics only	Variable to none
IP02-3: Include HF?	Nothing specific. HF stated to be a consideration in accident investigation procedures	Nothing specific. HF stated to sometimes be a consideration in accident investigation procedures	None
IP02-4: Include psychological forces?	Only Safety Conversation and Conversation Cards. STOP principle	Engage in Operator system	Engage in Operator system
IPO3- Psychological Capital (Research Objective 2)	P2	P2	P2
IP03-1: Avoidance of production vs. safety conflict	Only Safety Conversation and Conversation Cards. STOP principle	Engage in Operator system	Engage in Operator system
IP03-2: Driven by safety strategy and included in scorecard	No	No	No
IP03-3: Offshore workforce description	Safety focused	Comply with Operator safety expectations	Comply with Operator safety expectations
IP03-4: PsyCap measurement for offshore workers?	None	None	None
IPO4 - Safety Leadership (Research Objective 4)	P2	P2	P3
IP04-1: Safety leaders in the offshore workforce	Safety held as a core value and in-built across all leadership training	Safety held as organisational value and included across leadership training	Nothing specific. Only as good as the last job with Operator company
IP04-2: Leadership style linked to strategy and included in scorecard measures	No	No	No
IP04-3: Safety leadership assessment or measurement?	Staff appraisal but not safety leadership specific	Staff appraisal but not safety leadership specific	Informal to none
IP05 - Safety Climate Research Objectives 4 & 5)	P3	P3	P3
IP05-1: Safety Climate measurement	None	None	None
IP05-2: Driven by safety strategy and included in scorecard	Not included	Not included	Not included
IP05-3: Validated measurement tool?	None deployed	None deployed	None deployed
IP05-4: Effect of Operator control of work rules?	Own company rules and drives compliance	Drives compliance; awareness of negative consequences for failure	Drives compliance; awareness of negative consequences for failure

Table 4.2 Content Analysis Summary

4.1.1 Organisational Typology

The first focus area of the semi-structured interview was a consideration of organisational typology from Operator, Contractor and Sub-contractor interviewees. The organisational typology categorisations were drawn from the Miles and Snow (1978) consideration of organisational adaption seen in response to business environmental change and associated uncertainty for each of their seminally identified organisational types: the Defender; the Prospector; the Analyzer; and the Reactor. The organisational types were not identified to the interviewees on the marking grid provided to them during their individual interviews.

Table 4.3 provides a summary of interview perceptions across the thirty-nine Operator, Contractor and Sub-contractor interviewees. Each of the thirty-nine interviewee was readily capable of identifying where their employing organisation was placed the Operator's Value Chain, Operator, Contractor, or Sub-contractor. Attempting to determine the organisational typologies making up the Operator's Value Chain, the interviewees were provided with the marking grid (Appendix 3) and requested to identify the statements that best described their organisation, giving regard to several key considerations: product/market sector; senior managers; new opportunities; major adjustments to structure, technology, or operating methods; and improving efficiency of existing operations.

From the perceptions of Operator interviewees, it was observed that they described an Exploration and Production (E&P) company that strongly exhibited the characteristics of a Defender-type organisation, although some responses were rated between Defender and Prospector-type organisations. This was an entirely plausible position of perception given that Miles and Snow (1978: 30) acknowledge that any one typology is unlikely to encompass every form of organisational behaviour given that that the world of organisations is "*too changeable and complex to permit such a claim"*. From the responses provided on the marking grid, 76% identified with a Defender-type organisation with the remaining 24% identified as falling between Defender and Prospector.

	DEFENDERS		PROSPECTORS		ANALYZERS		REACTORS
Product/Market Sector	Narrow and specialised area of operation		Continually searching for new opportunities;		Operate typically in one stable and one changing domain		Frequently perceive change and uncertainty in their area of operations
Operator	**10**	**6**		**-**	**-**	**-**	**-**
Contractor	**-**	**2**	**12**	**-**	**-**	**-**	**-**
Sub-contractor	**-**	**-**		**-**	**4**	**2**	**3**
Senior Managers	Highly expert in the focused area of operations		Innovators capable of monitoring a wide range of environmental conditions, product/market trends and events.		For stable product/market sectors emphasise formalised structures and processes to achieve efficiency		No clearly articulated organisational strategy. Unable to respond particularly effectively to change in product/market sector
Operator	**11**	**5**	**-**	**-**	**-**	**-**	**-**
Contractor	**2**	**3**	**9**	**-**	**-**	**-**	**-**
Sub-contractor	**-**		**-**	**-**	**5**	**3**	**1**
New Opportunities	Seldom search outside the existing sphere of operations		Can be creators of change and uncertainty so competitors must respond to their lead		Watch competitor closely for new ideas and adopt those that appear very promising		Reactive rather than proactive to product/market environmental pressures
Operator	**10**	**6**	**-**	**-**	**-**	**-**	**-**
Contractor	**-**	**1**	**13**	**-**	**-**	**-**	**-**
Sub-contractor	**-**	**-**	**-**	**-**	**6**	**-**	**3**
Major adjustments to structure, technology, or operating methods	Engaged in continual improvement but seldom required to make major adjustments		Driven by responses to emerging product/market trends. Regular experimental responses to emerging trends		Typically associated with adopted new ideas		Adjustments tend to be driven by product/market sector pressures
Operator	**14**	**2**	**-**	**-**	**-**	**-**	**-**
Contractor	**2**	**1**	**11**	**-**	**-**	**-**	**-**
Sub-contractor	**-**	**-**	**-**	**-**	**6**	**-**	**3**
Improving efficiency of existing operations	Area of primary focus is to ensure maximum efficiency of existing operations		Not completely efficient because of focus on product and market innovation		Area of primary focus is to ensure maximum efficiency for stable operations		Lack of strategic alignment impedes efficiency improvement
Operator	**16**	**-**	**-**	**-**	**-**	**-**	**-**
Contractor	**5**	**2**	**7**	**-**	**-**	**-**	**-**
Sub-contractor	**-**	**-**	**-**	**-**	**5**	**2**	**2**

Table 4.3 Identification of Organisational Typology

Interviewees from Contractor organisations predominantly identified their employing organisation to be more of Prospector in character. Again, there were instances where identification of defining characteristics was made that fell between the Prospector and the Defender-type organisation. Entirely plausible as previously described (Mile and Snow, *ibid*). From the responses

provided on the marking grid, 74% identified with a Prospector-type organisation, 13% identifying as between the between Defender and Prospector-type organisations, and 13% as Defender-type.

The Sub-contractor group was diverse. Personnel interviewed came from a broad spectrum of organisational types representing small and medium sized enterprises (SME) with fewer than 250-employees, micro-businesses with fewer than 9-employees, through to self-employed personnel working on a sub-contract basis through a Limited Company status. The responses obtained from the semi-structured interviews indicated a less clear-cut perception of typology than was obtained for the Operator and Contractor interviewees, overtly perceived as Defender and Prospector-type organisations, respectively. From Sub-contractor responses provided on the marking grid 58% reflect an Analyzer-type organisation, 27% a Reactor-type and the remaining 15% falling between the two typologies. This was concluded to be entirely plausible, both from a Miles and Snow perspective (as in the case of Operator and Contractor responses) but also from the extent of diversity within the Sub-contractor group.

4.1.2 Safety Strategy

Proceeding on from organisational typology to consider safety strategy as an integral part of organisational strategy, differences were acknowledged between the Operator, Contractor and Sub-contractor groupings. From Operator interviewees there was no awareness of a documented safety strategy, however it was unanimously confirmed that the Operator had clearly documented safety goals and performance targets that were confirmed and frequently re-set on an annual basis set each year. The goals and targets were said to be measured and monitored on a continual basis through established leading and lagging performance indicators. As a strategic tool, an Assurance Board process had been established to meet on a quarterly basis with a membership comprised of the UK President plus the Senior Leadership Team to assess performance, intervene, and adjust the direction of safety strategy execution if needed. The Assurance Board process considered leading and lagging indicators related to: Major Accident Hazard (MAH) Prevention; Asset and Operating Integrity; Operating Management

System implementation. The Operator organisation was said to be fully aligned with the global corporate business and its established safety priorities. Further, the corporate Safety Management System Standard (foundation for the UK Operators OMS) embodied the Deming Cycle of Plan, Do, Check, and Act. Therefore, it was aligned with key international safety management system standards for example ISO 45001: 2018 Occupational Health and Safety Management Systems and the UK Health and Safety Executive's HSG65 Managing for Health and Safety. Annually established safety goals, aligned with corporate safety goals, were stated to be translated into functional (departmental goals) and subsequently carried through into individual goals and objectives. Delivery against established safety goals and objectives was to be achieved through safety management governance defined within the Operators documented Operating Management System (OMS). Interviewees from the Operator organisation consistently perceived strategy to be communicated through the established OMS plus daily, weekly, monthly meetings where safety is always the first agenda item. In addition, there are also Quarterly Townhalls with the UK President plus Departmental monthly safety meetings. At these events, safety is also the first Agenda item. From the Operator interviews, personnel consistently believed safety strategy to be clearly embodied in two statements. Firstly, that '*No job is so urgent or important that we can't take time to do it safely'.* Secondly, the need to be '*Always Professional, Always in Control, every work site, every task, every day'.* These messages are consistent and highly visible both onshore and offshore. They were stated during interview to apply for all persons working for or on behalf of the Operator, Staff, Contractors, or Sub-contractors.

Operator interviewees confirmed that safety, both leading and lagging measures, was included as a measure in the organisational (UK and global) scorecard. The other elements of the scorecard were stated to be Operational Performance, Financial performance, Strategic Milestones and Total Shareholder Return. Given the business scorecard to be a measure of organisational strategy attainment it was concluded for the Operator that safety was an integral part of its wider organisational strategy. A number of the Operator interviewees were willing to [and did] share the UK organisations Scorecard. It was not included within the research document text, nor as an attachment to protect the anonymity of the Operator

organisation. The use of Operator documents had not been approved when research permission was originally granted by the UK President. Further, no offer of similar document provision was received from either Contractor or Sub-contractor interviewees so to have utilised only Operator documentary evidence may have biased the safety science research. However, the Researcher was able to confirm that Human Factors (HF) metrics were not included as either leading or lagging metrics within the part of the safety element of the business scorecard. It was confirmed that there was some HF inclusion within OMS procedures, for example within Asset Safety cases, but it is very high level and aimed at positively influencing Hazard Identification only. Several of the interviewees stated that HF is acknowledged within the OMS incident investigation procedure with regard to identifying human causes of accidents and incidents where HF analysis is intended to form an important part of the investigation process, recognising that human behaviour should be considered alongside technical causal factors during an investigation. None of the interviewees gave recognition that the dynamics of social interaction as an element of HF possesses an ability to defeat safety barriers (Storseth et al., 2014) resulting in accident, incident and MAH. Several interviewees recalled HF training within the Operator eight to ten years previously with a strong focus on the reasons for Human Failure being errors and violations. Further, the Operator organisation had employed an eminent HF Academic and Researcher (stated to have been most likely 2013 or 2014) only to eliminate the post during the 2015 Oil & Gas industry downturn; three of the interviewees stated the position had been considered a luxury the business could not afford. From the Operator personnel interviews it was concluded that the understanding of HF is not mature within the Operator organisation, predominantly focusing on the technical and organisational antecedents of human failure and zero cognition for the dynamics of social interaction. An additional question was presented to both HSE Auditors interviewed. During Contractor (and Sub-contractor) HSE audits, either pre- or post-contract award, was the topic of safety strategy examined to any level of detail. Both interviewees indicated that safety strategy was not a specific topic of audit investigation. During pre-contract award audits, it was stated that focus was always given to safety policy, leadership, and planning activities, the latter particularly for safety objectives and their attainment. Both interviewees confirmed that these activities were not necessarily strategy based in content,

rather more centred on compliance with applicable safety management system standards, for example BS ISO 45001:2018 Occupational health and safety management systems or Operator internal safety management system requirements.

From Contractor interviewees, a similar perspective was provided around safety strategy as had been presented by interviewees from the Operator organisation. Safety is clearly a strong organisational value in all cases but none of the interviewees recalled seeing a stand-alone safety strategy document within their own organisations. The existence of safety performance as part of a balanced scorecard for each of the organisation represented by interviewees was acknowledged. However, the safety measurements included within the scorecard were lagging in nature, for example Lost Time Injury (LTI) and Recordable Injury (RI) Frequency rates. The claims made during interview were verified by the Researcher reviewing a sample of Annual Reports published by the Contractor organisations in question. Communication of the safety strategy was through the documented safety management system within each Contractor organisation. Safety metrics both leading and lagging are set for each contract with the Contractor organisations safety strategy said to influence the process. The agreed metrics are formally reviewed on at least a monthly basis between the Operator and Contractor. Safety goals and objectives feed through into individual goals and objectives and are measured through formal performance appraisal systems. All Contractor personnel interviewed confirmed that there was no specific mention of Human Factors within strategy or on the business scorecard. Like the Operator organisation, Contractors do consider HF from the organisational and technical aspects of Human Error and consider behavioural causes of accident and incident. There was no acknowledgement of the dynamics of social interaction as an element of HF with potential to defeat established safety barriers leading to accident and incident events. As per the Operator HSE Auditor interviewees, the Contractor HSE Auditors were asked if, during HSE audits of their organisations supply chain (either pre- or post-contract award) was the topic of safety strategy examined to any particular level of detail, including Human Factors content. Both interviewees indicated that safety strategy was not a specific topic of audit investigation and that audits were significantly focused

on applicable safety management system standards, for example BS ISO 45001:2018, or [Contractor] internal safety management requirements for in-place contracts or those due to be awarded.

From Sub-contractor personnel interviewed there was less awareness around safety strategy. Interviewees from micro-business and Limited Company Sub-contractors confirmed that their organisations had no safety strategy established, documented, and communicated. Working entirely for Operator or Contract organisations they were engaged on the basis of their technical competencies and the most important thing was to follow the safety management governance and control of work arrangements provided by the organisation that they were working for. Sub-contractor interviewees from larger organisations frequently referred to the independent Third-Party certification of safety management system (for example BS OHSAS 18001:2007 and ISO 45001:2018) held and the necessary establishment of objectives and programmes for attainment as safety strategy. In a similar vein to Sub-contractors from smaller organisations, all interviewees stated the necessity of following the safety management governance and control of work arrangements established by the organisation they were engaged to work for. Interviewees considered compliance with such governance and control of work arrangements more important, and relevant to them, than any safety strategy developed and executed by their employing organisation. Considering Human Factors, Sub-contractor interviewees had no awareness of aspects included within their employing organisations safety strategy (if one indeed existed). The majority of interviewees confirmed that their awareness and knowledge of Human Factors had been gained from experiences working for the Operator organisation; several interviewees confirmed that the Operator had a Human Factors focus circa 2012 and 2013 with training on human failure (error versus violation) and human performance difficulty. The means of avoiding normalisation of warnings, consensus mode decision making, confirmation bias, and group think was confirmed by most interviewees as following the control of work arrangements and staying inside the safety triangle.

4.1.3 Workforce Psychological Capital

Workforce psychological capital was identified as a topic of focus for the semi-structured interviews, with interviewee's being asked how their respective organisations ensure the offshore workforce does not succumb to production versus safety pressures; what activities are deployed to support and encourage both workers (followers) and leaders to avoid this [potentially dangerous] pitfall? Operator company personnel interviewed consistently mentioned the right that everyone working offshore has to stop the job if they witness or hear something that they think may be unsafe and have the potential to trigger an accident or incident. It is more formally referred to as the Stop Work Authority and the process applies to Operator, Contractor and Sub-contractor personnel. For the Operator company examined during the research, the Stop principle was stated to always contained in the Green Hat induction provided by the Offshore Installation Manager (OIM) to personnel oncoming to an asset they have never visited before. Also, during the Induction talk, attention is drawn to the fact that all work conducted on the asset must be completed in accordance with the Operators control of work arrangements. All persons are advised to follow the Safety Triangle (Figure 4.1) and work within the Law, follow correct policies and procedures (including the Operator control of work arrangements), and to work within their own level of competence and training.

Figure 4.1 The Safety Triangle

The Stop Work Authority was stated to be supplemented by the deployment of a Safety Observation and Safety Conversation Card reporting system. The system deployed was developed as part of the Step Change in Safety (an Oil & Gas Industry trade association) Safe Working Essentials initiative. Personnel have been trained in how to conduct and receive conversations, plus how to respectfully make observations. The considered opinion of the

Operator interviewee majority was that these initiatives (tools) were deployed to assist with effective implementation of the safety and organisational strategy rather than as a direct result of inclusion within the strategy itself. Stop Work Authority plus Safety Conversation and Observation Cards are accepted, if not standard, components of a wider industry safety culture. The initiatives and tools are intended to empower individuals to have confidence to always work safely, without fear of reprisal if they speak-up over safety concerns in the workplace. Interviewee's from Operational functions stated the organisation had, for several years engaged with a consulting company to deliver Safety Coaching both on and offshore. The declared purpose was to create safer workplaces through consistency, reliability, and improved resilience. The Safety Coaches worked with both leaders and followers. Onshore the Safety Coaches worked with staff personnel. At offshore assets, the Coaches worked with Operator, Contractor, and Sub-contractor personnel. The Operator organisation was not reported to engage in any measures of psychological capital within the workforce. The assessment of effectiveness for the initiatives and tools deployed appears to be reliant on the outcomes from accident and incident investigations; was an accident the result of human failure (error or violation) or was it due to inadequate leadership and supervision? Specifically addressing the HSE Auditors, the question was asked that when conducting audits internally, or externally on supply chain organisations, were psychological forces (position, pressure, power) and the dynamics of social interaction ever considered when auditing topics such hazard analysis, hazard identification, risk assessment and risk control? The response was uniform "*no*" from both Auditors who confirmed that the previously mentioned topics were predominantly engineering and technical in nature.

From Contractor organisation interviewees it was determined that individuals were selected to work on the Operators contract, both on and offshore, based on their competence levels reflected through education, training, skills, and experience. Specifically, regarding the avoidance of a production versus safety pitfall, all interviewees referred to the Stop Work Authority and the Safety Conversation and Observation Card system deployed. It was unanimously commented that on the Operator's assets, following the client's control of work systems was of paramount importance; the Operators safety

expectations were clearly stated and [believed to be] understood by all. Frequent reference was made to the importance of staying within the Safety Triangle. None of the Contractor interviewees referred to the Safety Coaches being used by the Operator on and offshore. No measures of psychological capital levels appear to have been made by any of the Contractor organisations included in the semi-structured interview sample. Like the Operator organisation, the assessment of effectiveness for the initiatives and tools deployed appeared to be reliant on the outcomes from accident and incident investigations. Several of the interviewees commented that it could be difficult gaining access to accident and incident investigation data for events involving Contractor personnel but where only Operator personnel had conducted and reported the investigation. This was said to be typically when there were potential Legal consequences (such as an injury claim) however, it impeded the Contractor organisations from fully implementing their internal systems for people management. Two of the interviewees stated that their organisations were subject to safety management system audits by the Operator as a means of creating improvement. When further discussed, the 'human' element of the audits was confirmed to have only addressed personnel competence and training topics, but no aspects of psychological capital for Operator contract personnel deployed on or offshore. Specifically addressing the HSE Auditors as in the Operator semi-structured interviews, the question was again asked that when conducting audits internally, or externally on supply chain organisations, were psychological forces (position, pressure, power) and the dynamics of social interaction ever considered when auditing topics such hazard analysis, hazard identification, risk assessment and risk control? The response was also a uniform "*no"* from both Contractor HSE Auditors.

From Sub-contractor interviewees it was clear that individuals were selected for work based on their competence levels reflected through education, training, skills, and experience. At the offshore asset level, all interviewees confirmed that there was total reliance on the Operator's control of work systems and governance to ensure safe operations. In a similar manner to interviewees from the Operator and Contraction organisations, Sub-contractor interviewees referred to the in-place Stop Work Authority plus the Safety Conversation and Observation Card process. Staying within the Safety

Triangle was frequently referred to. There was no indication of any formal attempts being made to tackle issues of confidence, hope, resiliency, and optimism for Sub-contract personnel. Personnel interviewed confirmed there were no formal measurement of psychological capital levels for Sub-contractor personnel deployed to offshore assets. Competency was acknowledged by several interviewees to be critical for delivering competitive edge to Sub-contract businesses.

4.1.4 Safety Leadership

Addressing Safety Leadership as a focus area of semi-structured interviews, it was consistently stated by Operator interviewees that the organisation desired to put leaders onto offshore assets who were aligned with the organisations ethics and values and who provided strong safety focus. This was confirmed not to result directly from inclusion in strategy or a metric on the scorecard. Rather, a safety strategy enabler to deliver positive safety outcomes and performance. From Operator interviews it was established that the Operator organisation has [globally] established a number of leadership competencies: Leading Self (Takes Accountability/Drives Performance/Makes Decisions) Leading Others (Communicates Effectively/Partners Collaboratively/Builds Talent and Teams/Empowers Others); and Leading the Business (Thinks Strategically/ demonstrates Financial and Quantitative Acumen/Leads Change). These competencies were stated to be linked to the grading structure and career map for staff personnel. As a core value, Safety was considered by Operator interviewees to be an integral part of the established leadership competencies rather than a specific and stand-alone competency itself. Leaders were encouraged to participate in a 360-degree feedback programme as an input to their annual appraisal, taking feedback from subordinates (followers), their line manager, peers and interested senior stakeholders from within the business. The feedback process was said to be structured around the career map and the established leadership competencies; safety leadership was confirmed not to be an element of the process. The Researcher concluded that aspects of authentic leadership attributes (transparency, internalised moral/ethical perspective, balanced processing, and self-awareness) were visible from the identified leadership competency elements, but that safety leadership was driven through the

organisational value position on safety. Engineering and technical competency programmes had been established for all offshore asset-based positions to help ensure delivery of safe and efficient production; competency attainment levels were said to be monitored monthly by Human Resources and Operations management. Interviewees confirmed there were no established leadership competency programmes. Other than the formal performance appraisal system, the Operator interviewees confirmed to the best of their knowledge that there was no other deployment of leadership assessment or measurement. Scepticism was expressed by several Operator interviewees over the reliability of performance appraisal to effectively assess leadership skills and attributes. Appraisals were said to be highly task attainment focused, biased towards technical rather than soft skill elements, plus tied to a force-ranked performance rating score. Beyond six-monthly and annual performance appraisals, the assessment of safety leadership effectiveness appeared to be reliant on the outcomes from accident and incident investigations; was an accident the result of inadequate leadership and supervision? Specifically addressing the HSE Auditors, the question was asked that when conducting audits internally, or externally on supply chain organisations, was safety leadership a specific topic. Both Operator HSE Auditors confirmed that leadership was a regular audit topic both internally and externally, primarily from a standards compliance perspective given that published safety management standards contain requirements relating to Leadership, for example Section 5.1. of BSI ISO 45001:2008 (Leadership and commitment). Both Auditor interviewees confirmed that the audits conducted did not result in the identification of safety leadership deployed by the auditee organisation, for example authentic, charismatic, transactional, or transformational. The interviewees confirmed that they would not feel capable of making such an assessment if required to.

The Contractor personnel interviewed confirmed that their employing organisations engaged in a variety of leadership training activities. In a position not dissimilar to the Operator organisation feedback, interviewees reflected that safety was considered an organisational value and so was incorporated into leadership training rather than being a stand-alone leadership training activity itself. Evaluation of effective safety leadership was considered by interviewees to be achieved through improving safety

performance, as evidenced by key lagging performance metrics such as Lost Time Incident and Recordable Injuries. These performance measures feature on their business scorecards. In addition, several interviewees confirmed that their employing organisations also evaluated safety leadership by measuring and monitoring leaders' engagement [and visibility] in safety related activities, for example conducting asset and work site visits, participation in safety audits, safety inspections and verifications. These lagging performance measures against established performance targets do not feature on the business scorecards. Several of the interviewees commented that it was frequently difficult for their leaders to meet such performance targets because they were heavily dependent on the Operator organisation to provide bed space and accommodation on offshore assets for what was frequently viewed as non-production critical activity. All Contractor personnel interviewed stated that their employing organisations had established annual performance appraisal processes. In a similar manner to the Operator organisation, the Contractor appraisal processes were stated to be heavily biased towards goal attainment and task accomplishment. With safety considered to be an integral company value, safety leadership was not a specific appraisal topic for any of the Contractor personnel interviewed. All of the Contractor personnel interviewed commented that the alternative means of determining safety leadership effectiveness within their employing organisations was through accident and incident investigation outcomes that delivered inadequate supervision or leadership as a root cause (direct or contributing). However, several of the Contractor interviewees commented that getting such information from the Operator organisation could be problematic, normally due to the legal position regarding potential injury and liability claims and was therefore of limited value. As per the Operator semi-structured interviews, the Contractor HSE Auditors were asked that when conducting audits internally, or externally on supply chain organisations, was safety leadership a specific topic. Both HSE Auditors confirmed that leadership was a regular audit topic both internally and externally, again primarily from a standards compliance perspective. Both Auditor interviewees confirmed that the audits conducted did not result in the identification of safety leadership deployed by the auditee organisation, for example authentic, charismatic, transactional, or transformational.

Several of the Sub-contract interviewees commented that their company personnel offshore were only as good as their last job, with the Offshore Installation Manager's (OIM) being law. Three of the Sub-contractor interviewees commented that the principle of Not Required Back (NRB) remains in the shadows despite Oil & Gas UK introducing guidelines during 2009 setting out the principles and process to be followed in the event of permanent removal of contractor personnel from an offshore installation. The guidelines were endorsed by both industry and the trade unions and introduced in response to workforce concerns that the lack of a clear and transparent process could potentially prevent individuals from raising safety concerns. The three interviewees stated, for the Operator organisation, that everyone knew exactly who the *difficult* OIM's and Operations Managers were.

4.1.5 Safety Climate

The final topic addressed by the semi-structured interviews was Safety Climate. Operator personnel interviewed made repeated reference to the organisation having a long heritage with a strong and positive safety culture. When asked to describe what safety culture meant, a variety of responses were achieved such as '*our culture is based on the safety triangle'*, '*it's the way the company has always just done things, safely*', '*no job is so urgent or important that we can't take the time to do it safely*' and '*culture is our processes, procedures and the desire our people have to work safely all of the time*'. None of the Operator personnel interviewed considered safety culture to be as a direct result of the business scorecard, rather the scorecard was viewed as a means of maintaining the culture. Nobody interviewed from the Operator organisation could recall ever having been asked to participate in a culture (or specifically safety culture) survey. When asked how safety culture was measured by the organisation, all interviewees referred the lagging safety performance data of accident and incident rates as proof that the organisational value of safety combined with a strong safety culture delivered [near] year-on-year improvement in accident and incident rates. When asked to discuss safety climate as distinct from safety culture, most of the interviewees were unaware that distinctions could be drawn between safety culture and safety climate with research Guldenmund (2000)

concluding that the assessment of safety culture may provide insight into attitudes leading to safety performance improvement and the avoidance of major accidents; measurement of safety climate might be utilised as an alternative safety performance indicator beyond the *traditional* recording of accident and incident events. Unanimously, the interviewees confirmed that there had been no safety climate measure conducted by the Operator organisation involving staff, Contractors or Sub-contractors. It was concluded that without a measure and consideration of safety climate, the Operator organisation may experience some difficulty in moving beyond its continued and heavy reliance on lagging safety performance data.

For Contract personnel interviewed a similar picture was presented by interviewees; safety was a core value of their employing organisations and the importance of developing and maintaining a strong safety culture was recognised as a high priority and business critical activity. Personnel interviewed were not familiar with the concept of safety climate and its potential for use as a safety performance indicator. None of the interviewees could recollect any safety climate measurements being taken within their organisations and it was not recognised to be a scorecard element either at the corporate or contract level. Several interviewees recalled organisational culture questionnaires being applied during the past five years, but they were very much researching staff employee satisfaction levels; they were not applied to non-staff personnel working for or on behalf of the Contract organisation. Interviewees from one of the Contractor organisations stated that they had commenced safety culture measurements within their wider business organisation. On attempting to perform safety culture measurements on their personnel working offshore on one of the Operators assets, it was met with significant resistance by Operator senior leadership and the asset OIM's. The interviewees confirmed that the Operator was concerned about a culture within a culture perception when, offshore, everything was controlled by the Operator and that meant safety culture too. Safety culture measurements had subsequently been suspended by the Contractor organisation with the process to be re-considered at a future date. All Sub-contract personnel interviewed stated that they were unaware of safety climate measurements being made within their own organisations and no scorecard inclusion should one exist. Also, none had been invited to

participate in any such measurement exercises at the Contractor or Operator level. When asked to consider the effect of working under the Contractor or Operator control of work arrangements on sub-contractor safety focus and safety performance the responses received were very consistent. On the Operators assets the clear expectation is for Sub-contractor leaders and followers to display the correct attitude to safety. Following the Operators control of work arrangements was stated by most interviewees to be imperative, as was participation in the safety conversation and observation initiatives, plus staying within the safety triangle. The message was stated to be clear on offshore assets that there would be [adverse] consequences in the event of someone (Operator, Contractor, or Sub-contractor) stepping out of the safety triangle.

4.2 QUANTITATIVE DATA

4.2.1 Offshore Workforce Safety Study

Quantitative data was obtained from the research population during 2018 by means of three credible and recognised data collection instruments combined into a single Offshore Workforce Safety Study created specifically for the purpose of the original research.

Firstly, the Authentic Leadership Questionnaire - ALQ (Avolio et al., 2007) both 'Rater' and 'Self-Rater' component scales were included for research purposes. The ALQ had previously undergone extensive validation activities to determine construct reliability and validity. Secondly, the Safety Climate Assessment tool (SCT) developed by the Health and Safety Laboratory (HSL). The scale was originally published by the Health and Safety Executive in December 1997 before being withdrawn during early 2007 and subsequently revised (Sugden et al., 2009) into the version utilised (V1.0) during the research. The third and final scale utilised was the Psychological Capital Questionnaire – PCQ (Luthans et al., 2007); the 'Self-Rater' version was utilised for the study. The PCQ had also previously undergone extensive validation activities to determine construct reliability and validity. All three data collection tools were unaltered for the purposes of the research

undertaken to ensure there was no detrimental impact upon assessed construct reliability and validity.

4.2.2 Data Population and Study Response Rates

Table 4.4 details the responses received to the Offshore Workforce Safety Study sent out to the seven individual offshore Assets, described in Chapter 3. An overall response rate of 48.8% was considered positive for the organisational research undertaken. For example, Baruch and Holtom (2008) noted a response rate of 37.2% to be a positive indicator of research data validity. The returns from all assets except one (Asset A6) were either close to or in exceedance of the Baruch and Holtom (*ibid*) 'good' response rate. Assets A2 (54%), A4 (51.5%) and A5 (74.8%) were considered particularly strong returns. However, there was no assignable or discernible cause for Asset A6's weak return percentage (9.6%); the timing, instructions and application of the Study were identical with all other assets. Overall, the strong response rate was important to the research given that lower returns may have resulted in the introduction of nonresponse bias, potentially generating misleading information about the safety science issues being researched through the specifically constructed Study (Shih and Fan, 2009).

Asset Identifier	Type	Operating Phase	Issued	Returned	Return %	Used	Discard
A1	Production Platform	Decommissioning	100	46	46	46	0
A2	Production Platform	Decommissioning	100	54	54	48	6
A3	Production Platform	Production with Asset Life Extension	100	44	44	41	3
A4	Production Platform	Production with Asset Life Extension	200	103	51.5	95	8
A5	Production Platform	Production with Asset Life Extension	250	187	74.8	168	19
A6	Drilling Rig	Well Plug & Abandonment Operations	125	12	9.6	12	0
A7	Drilling Rig	Well Exploration and Development	125	42	33.6	42	0
			1000	**488**	**48.80%**	**452**	**36**

Table 4.4 Offshore Workforce Safety Study Responses by Asset

A total of 36 from the 488 Study questionnaires returned were discarded prior to analysis. The reason for discarding returns included missing information from the "Points About Yourself" section, key for comparative analysis. There were also returns where part or whole sections had not been completed.

The applied Study questionnaires invited respondents to provide additional comments about leadership, safety climate and/or safety performance on the

asset they were working on. Of the 452 responses analysed there were only 9 containing comments. These comments are shown in Appendix 5 to the thesis; there were too few to enable trends in commentary to be identified. It may have been by administering the Study during the onboard weekly Safety Meetings (time-bound but ultimately voluntary) the offshore crews considered that a sufficiency of their time had been sacrificed to the exercise answering the Study questions and opted not to give additional time to further commentary. Two of the Study respondents who did provide additional information resoundingly expressed their reservations about the safety science research. Respondent A5-25 provided the statement "*I don't think most of these questions were anything to do with safety*" while respondent A5-68 summed the Study up as "*Another box ticking exercise*". This, regrettably, was interpreted by the Researcher to reflect an understanding of safety as simply being the absence of accidents, reflected through lagging accident and incident metrics data.

The population of surveyed offshore workforce respondents was profiled to illustrate the value chain make-up between staff, contractor and sub-contractor split and is illustrated in Figure 4.2 below:

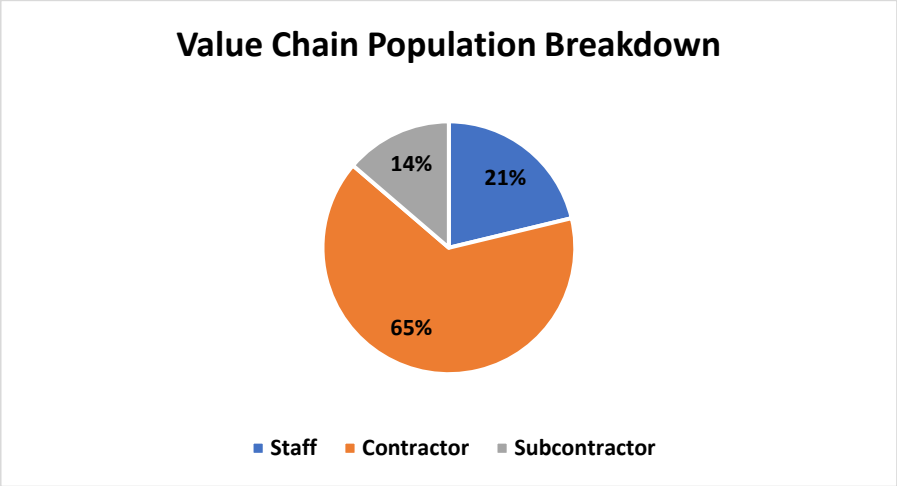

Figure 4.2 Value Chain Population Breakdown

Figure 4.3 provides a profile of respondent make up considering the contribution status of respondents (individual contributor versus leader of two or more people) between staff, contractor, and sub-contractor. From the data population it was observed that for Staff, Leaders represented 29.17% of respondents, 19.05% for Contractors and 29.03% for Sub-contractors.

Across all seven assets and in all cases, Individual Contributors comprised the respondent majority, with Leaders of 2 or more people making up a range of 17.89% to 41.67% of respondents.

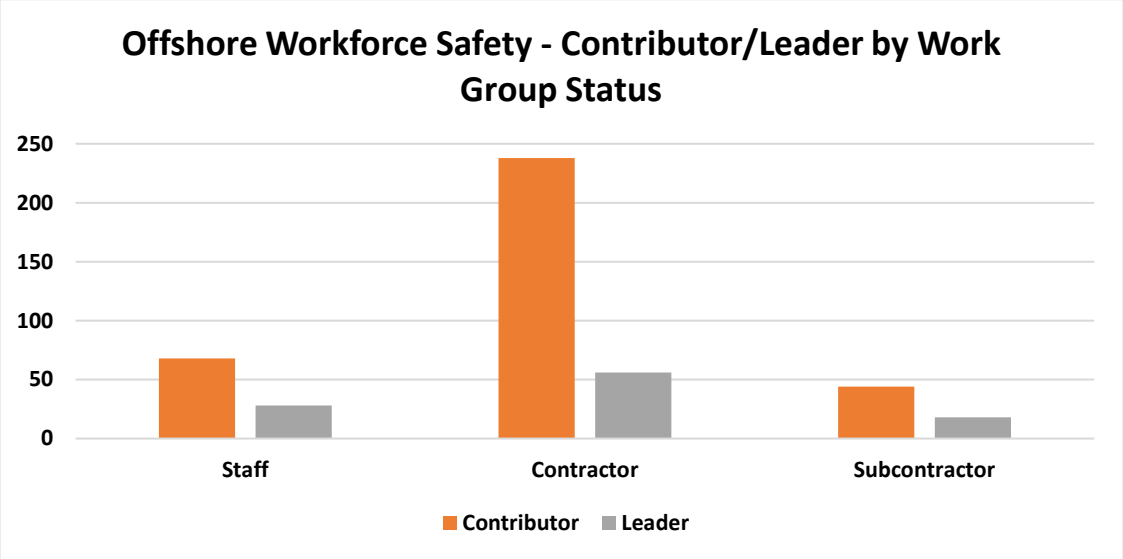

Figure 4.3 Individual Contributor vs. Leader Breakdown by Work Group

Upon completion of each Study questionnaire, the respondents were requested to indicate their thoughts on the ease or difficulty of completion for the data collection. The purpose was to confirm "*face validity*" (Saunders et al., 2009: 394); if the questionnaire had not made sense to the respondents then retrieved data viability may have been undermined, possibly unreliable. Figure 4.4 illustrates the overall ease of completion status across the data population.

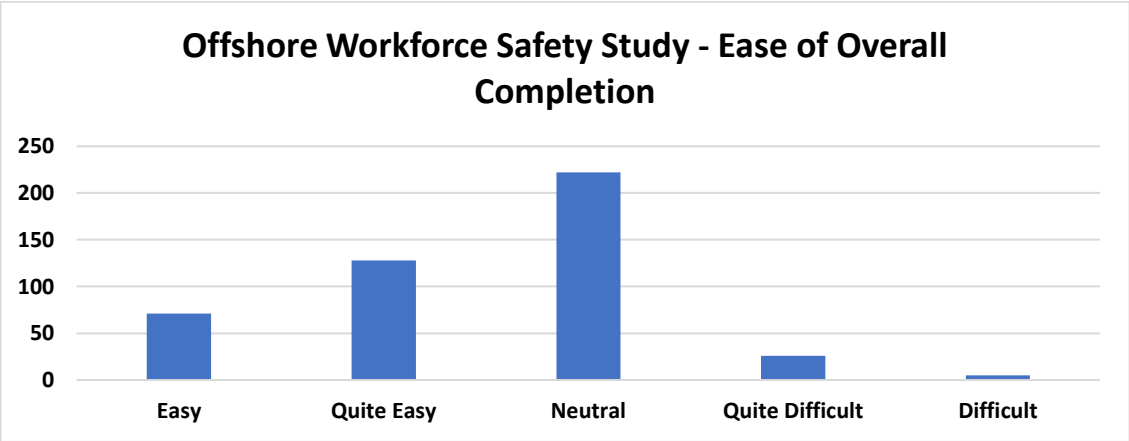

Figure 4.4 Offshore Workforce Safety Study Ease of Overall completion

The raw data was concluded to confirm face validity with 44% of respondents considering the administered questionnaire to be 'Quite Easy' or 'Easy'; a further 49% or respondents were 'Neutral' in their consideration of ease or difficulty of completion. Only 7% of respondents considered completion of the questionnaire to be 'Quite Difficult' or 'Difficult'.

Figure 4.5 displays the ease of completion by work group type, i.e. operator company staff, contractor, or subcontractor while Figure 4.6 depicts the ease of completion by contribution status.

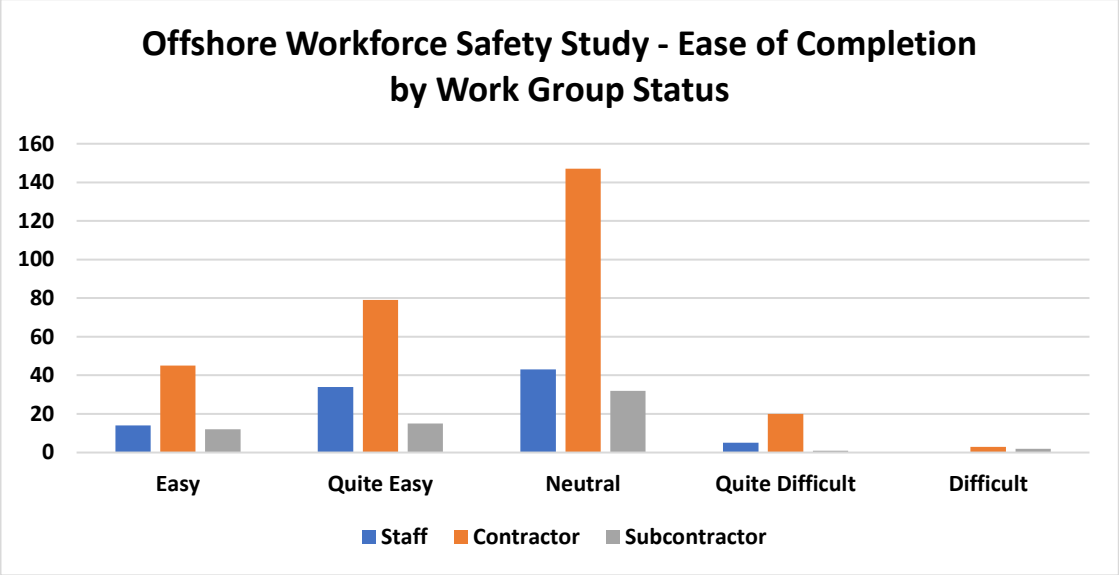

Figure 4.5 Offshore Workforce Safety Study Ease of Completion by Work Group Status

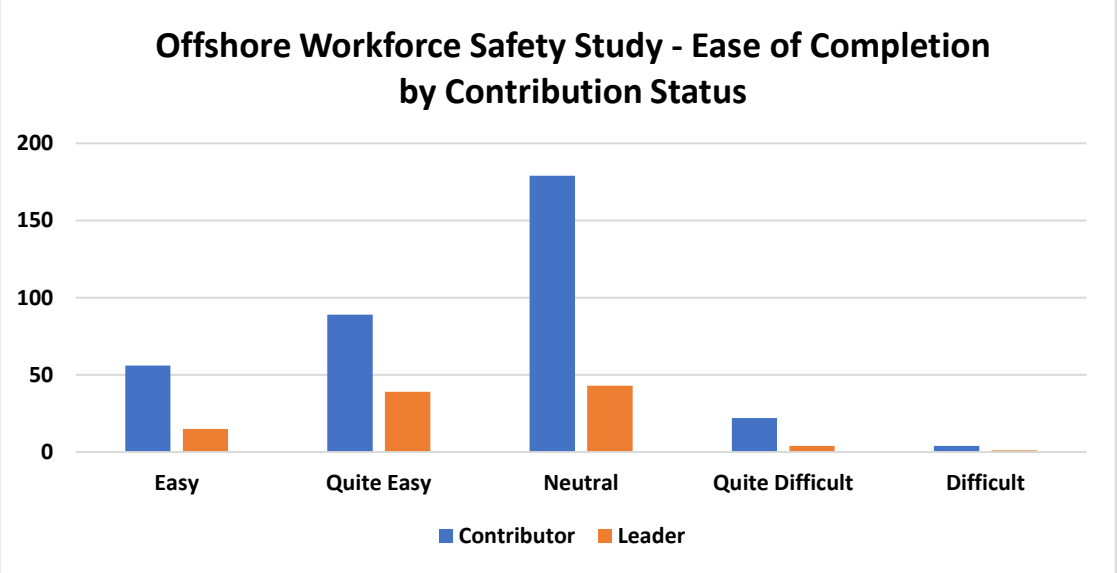

Figure 4.6 Offshore Workforce Safety Study Ease of Completion by Contribution Status

Overall, the visible skew from a 'Neutral' to 'Easy' response is clear for the overall value chain, by work group, and by contribution status. Face validity was therefore considered to have been achieved by the applied Offshore Workforce Safety Study instrument and its incorporated measurement scales. It was not possible to determine from the discarded questionnaires if difficulty was experienced with understanding the concepts being examined and questioned; whether difficulty was experienced with face validity of the Survey document and therefore an assignable cause for incomplete or inadequate questionnaire completion. However, neither could the possibility be explicitly excluded although the final discard percentage was only 7.38% of Survey documents returned. Although, during piloting of the Offshore Workforce Safety Study face validity as a substantially intuitive process was both considered and confirmed by the pilot group.

4.2.3 Data Reliability

The data collection instruments [selected and] utilised possessed previously demonstrated validity during their construct. However, there was a need during research to demonstrate that the data collection activity was free from random error. Cronbach's alpha (Cronbach, 1951) is one of the most widely used tests for demonstrating the internal reliability of data, determining whether the indicators that make up the data gathering scale are consistent; whether respondent scores on any one indicator tend to be affiliated with their scores on other indicators. The statistic provides an indication of the average correlation among all the items that make up the scale. Cronbach's alpha values range between 0.00 and 1.00. The closer Cronbach's alpha coefficient is to 1.00 the greater the internal consistency of the items in the scale. When there are reduced items in the scale, typically fewer than 10, Cronbach alpha values can be small and closer to 0.00. In such a situation, Pallant (2016) considers calculation and reporting of the mean inter-item correlation to be preferable. Optimal mean inter-item correlation values range from 0.2 to 0.4. Reliability statistics for the data collected during the Offshore Workforce Safety Study are summarised in Table 4.5, with the mean inter-item correlation reported for measures with fewer than ten scale items. With one exception the Cronbach's Alpha values obtained, supplemented by the inter-item correlation values as appropriate, demonstrate the internal

reliability of data gathered through the Offshore Workforce Safety Study. The values obtained confirm that respondents' scores on any one indicator strongly indicate relativity to their scores for other indicators, thus confirming consistency of measurement across the concepts being measured: Authentic Leadership; Safety Climate; and Psychological Capital.

Data Reliability Summary Table				
Authentic Leadership Questionnaire – Rater				
Scale	**N**	**Scale Items**	**Cronbach's Alpha**	**Inter-Item Mean Correlation**
Total Instrument	**452**	**16**	**.941**	**NR**
Transparency	452	5	1.00	1.00
Moral/Ethical	452	4	.863	.611
Balanced Processing	452	3	.746	.496
Self-Awareness	452	4	.874	.637
Authentic Leadership Questionnaire – Self-Rater				
Total Instrument	**102**	**16**	**.909**	**NR**
Transparency	102	5	1.00	1.00
Moral/Ethical	102	4	.774	.470
Balanced Processing	102	3	.539	.305
Self-Awareness	102	4	.744	.424
Safety Climate Tool				
Total Instrument	**452**	**40**	**.919**	**NR**
Factor 1: Organisational commitment	452	6	.723	.306
Factor 2: H&S oriented behaviours	452	6	.868	.515
Factor 3: H&S trust	452	7	.844	.446
Factor 4: Usability of procedures	452	5	.884	.601
Factor 5: Engagement in H&S	452	4	.858	.604
Factor 6: Peer group attitude	452	4	.511	.355
Factor 7: Resources for H&S	452	5	-.435	-.056
Factor 8: Accidents and near miss reporting	452	3	.836	.634
Psychological Capital Questionnaire				
Total Instrument	**452**	**24**	**.872**	**NR**
Efficacy/Confidence	452	6	.857	.512
Hope	452	6	.790	.396
Resiliency	452	6	.746	.350
Optimism	452	6	.517	.217

Table 4.5 Data Reliability Summary

The optimum Cronbach's Alpha value of 1.00 was obtained for the transparency scale within the Authentic Leadership Questionnaire, both Rater and Self Rater instruments. This indicates that across the data population there was total agreement on each item across the transparency semantic scale. While seeming to be *unlikely*, the coding for both instruments was checked and no errors, transcription or otherwise, were noted. According to SPSS statistical output the Cronbach's Alpha and inter-item mean correlation value negative values for SCT Factor 7 (Resources for Health & Safety) was due to a negative average covariance among items, thereby violating the reliability model assumptions. The coding for the SCT scale was checked with no transcription errors noted. However, a dichotomous trend was noted with responses to the three scale items in Factor 7 which may have presented as incorrect coding through the SPSS analysis. Despite this outcome for one of the eight SCT scales, the overall instrument achieved an overall Cronbach's Alpha value of .919, indicating strong internal reliability.

Further and more granular analysis was conducted on the individual data collection instruments, commencing with the Authentic Leadership Questionnaire (ALQ) which comprised the first two components of the Offshore Workforce Safety Study. The instrument contains scales addressing the distinguishing features of authentic leadership (Walumba et al., 2008) namely relational transparency, internalised moral and ethical perspective, balanced processing, and self-awareness.

4.2.4 Authentic Leadership Questionnaire Analysis

The first section of the Study to be completed was the ALQ Rater version where respondents were requested to identify their leader's style as they perceived it to be, rating it against a Likert Scale from 0 to 4 representing: *Not at all*; *Once in a while*; *Sometimes*; *Fairly often*; and *Frequently, if not always*. The scale, utilised in accordance with conditions of the Academic Licence, contained a total of 16 items. For example, *My Leader:*

- *says exactly what he or she means*
- *analyses relevant data before coming to a decision*
- *seeks feedback to improve interactions with others*

Obtaining a score for the total ALQ scale, also for each of the four components individually, involved calculation of the average for each item as per the instrument instruction. The overall result output is shown in Table 4.6 with a prominent feature being that the initial analysis demonstrates the ALQ scores is higher for leaders of 2 or more people than for individual contributors. This trend is consistent across the total research population plus all work group categories: Staff; Contractor and Sub-contractor.

Conducting further data analysis of the ALQ distinguishing features utilising the Independent-Samples Mann-Whitney U Test there was a statistically significant difference for the overall ALQ score between individual contributors and leaders of more than 2 people, the latter with the higher average score (3.20 versus 2.96). It was therefore concluded that leaders of 2 or more people perceive stronger authentic leader attributes in their own leaders than do personnel who are individual contributors with no leadership accountability and responsibility for others. Considering the individual feature scales and utilising the same technique for comparing groups it was noted that there was no statistically significant difference between individual contributors and leaders of more than 2 people for the transparency feature of authentic leadership despite individual contributors recording a lower feature score than leaders (3.21 versus 3.42). For this feature, the Null Hypothesis considering the distribution of transparency to be the same across both categories of contribution was retained. A statistically significant difference was noted for the remaining ALQ features of internalised moral/ethical, balanced processing and self-awareness reflected through the individual calculated scale scores, with the Null Hypothesis being rejected. In all cases the instrument scale scores for leaders of 2 or more people were higher than those for individual contributors (3.31 versus 2.96, 3.01 versus 2.83 and 2.97 versus 2.73 respectively). Overall, this further analysis discloses the basis for the earlier conclusion that leaders of 2 or more people perceive stronger authentic leader attributes in their own leaders than do personnel who are individual contributors. Further statistical analysis reviewing authentic leadership perceived differences based on work group contribution was conducted: Staff; Contractor; and Sub-contractor.

For Staff leaders of more than 2 people (N = 28) and individual contributors (N = 68) the Null Hypothesis that the total ALQ score would be the same across both categories of contribution was retained.

Authentic Leadership Questionnaire – Rater						
Grouping	**N**	**Total ALQ Score**	**Transparency Score**	**Moral/Ethical Score**	**Balanced Processing Score**	**Self-Awareness Score**
Total Data Population	**452**	**3.01**	**3.26**	**3.04**	**2.87**	**2.78**
Individual Contributor	350	2.96	3.21	2.96	2.83	2.73
Leader of 2 or more	102	3.20	3.42	3.31	3.01	2.97
Total Staff	96	2.90	3.21	2.97	2.73	2.56
Staff Individual Contributors	68	2.80	3.06	2.86	2.71	2.48
Staff Leaders	28	3.14	3.57	3.23	2.79	2.77
Total Contractor	294	3.02	3.28	3.04	2.87	2.79
Contractor Individual Contributors	238	2.98	3.26	2.98	2.84	2.75
Contractor Leaders	56	3.16	3.36	3.28	3.01	2.93
Total Sub-contractors	62	3.17	3.26	3.19	3.08	3.09
Sub-contractor Individual Contributors	44	3.06	3.20	3.06	2.95	2.95
Sub-contractor Leaders	18	3.43	3.40	3.53	3.37	3.43

Table 4.6 ALQ Rater Version Results

However, a statistically significant difference was recorded for the transparency feature of ALQ with the Null Hypothesis being rejected; leaders had a higher transparency score compared to individual contributors (3.57 versus 3.06). The Null Hypothesis was retained for the Internalised Moral/Ethical, Balanced Processing, and Self Awareness features of the ALQ (3.23 versus 2.86, 2.79 versus 2.71 and 2.77 versus 2.48 respectively).

Similar to the results for Staff personnel, the Null Hypothesis that the total ALQ score would be the same across both categories of contribution was retained for Contractor leaders of 2 or more people (N = 56) and individual contributors (N = 238). At an ALQ feature level the Null Hypothesis was retained for transparency, balanced processing, and self-awareness with leaders of 2 or more people presenting higher feature scores than individual contributors (3.36 versus 3.26, 3.01 versus 2.84 and 2.93 versus 2.75 respectively). The Null Hypothesis was rejected for the Internalised Moral/Ethical feature demonstrating a statistically significant difference between the two independent contributing groups; here again the leader score was higher than the individual contributor score, 3.28 versus 2.98.

For Staff and Contractor personnel the total ALQ score was greater for leaders in both working groups and the Null Hypothesis was retained. The Mann-Whitney U Test for total ALQ score for Sub-contractors resulted in rejection of the Null Hypothesis for the leader and individual contributor independent samples. A statistically significant difference in perceived levels of authentic leadership was calculated between leaders of 2 or more people (N = 18) and individual contributors (N = 44); leaders presented an ALQ score of 3.43 versus 3.06 for individual contributors. On this basis it was concluded that the gap in perceived authentic leadership levels is greater between leaders of 2 or more people and individual contributors within Sub-contractor personnel than Staff or Contractor personnel working on the offshore assets. This conclusion was supported through further granular analysis which demonstrated retention of the Null Hypothesis that the ALQ score would be the same across both categories of contribution for only the transparency feature (leaders 3.40 versus 3.20). The remaining features of Internalised moral/ethical, balanced processing, and self-awareness had the Null Hypothesis rejected. In all cases the leader scores were higher than those for

the individual contributors (3.53 versus 3.06, 3.37 versus 2.95 and 3.43 versus 2.95 respectively).

Table 4.7 details a summary of the ALQ outcomes, Null Hypothesis retained or rejected, by work group status considering the independent groups of leaders of 2 or more people and individual contributors.

	ALQ Score	Transparency	Moral/Ethical	Balanced Processing	Self-Awareness
Staff	RETAINED	REJECTED	RETAINED	RETAINED	RETAINED
Contractor	RETAINED	RETAINED	REJECTED	RETAINED	RETAINED
Subcontractor	REJECTED	RETAINED	REJECTED	REJECTED	REJECTED

Table 4.7 ALQ Rater Version Outcomes

In all cases, whether-or-not the Null Hypotheses were retained, the ALQ scores recorded by leaders of 2 or more people were higher than for those recorded by individual contributors.

The second instrument in the Offshore Workforce Safety Study was the Authentic Leadership Questionnaire Self-Rater version. In the same manner as the ALQ Rater version, respondents were requested to identify their own leadership style as they perceived it, judging, and rating it against a Likert Scale from 0 to 4 representing: *Not at all*; *Once in a while*; *Sometimes*; *Fairly often*; and *Frequently, if not always*. As per the Rater version, the scale contained the same 16 items but expressed in personal tense. For example, *As a Leader I:*

- *say exactly what I mean*
- *analyse relevant data before coming to a decision*
- *seek feedback to improve interactions with others*

The total and four component ALQ scales required calculation of the average for each item as per the instrument instruction. The overall result output is shown in Table 4.8.

The Kruskal-Wallis Test (sometimes referred to as the Kruskal-Wallis H Test) was utilised to compare ALQ scores on the same continuous variable for the three groups of leaders: Staff; Contractor; and Sub-contractor. The Null

Hypothesis of the ALQ total score being the same across all categories of leaders was retained. More granular analysis was conducted at the ALQ feature level with Null Hypothesis of the feature score being the same across all categories of leader was retained for transparency, internalised moral/ethical and balanced processing. The Null Hypothesis was rejected for Self-Awareness, Staff leaders presenting with the lowest feature score and Sub-contractor leaders with the highest. Overall, the highest level of perceived authentic leadership traits, as a total and at an individual feature level, came from Sub-contractor leaders of more than 2 people.

Authentic Leadership Questionnaire – Self-Rater						
Grouping	**N**	**Total ALQ Score**	**Transparency Score**	**Moral/Ethical Score**	**Balanced Processing Score**	**Self-Awareness Score**
Total Data Population	102	3.33	3.40	3.42	3.26	3.19
Staff Leaders	28	3.24	3.39	3.33	3.18	3.00
Contractor Leaders	56	3.31	3.34	3.40	3.25	3.24
Sub-contractor Leaders	18	3.50	3.61	3.61	3.43	3.32

Table 4.8 ALQ Self-Rater Version Outcomes

Table 4.9 summarises the results comparison ALQ scoring between how leaders of 2 or more people perceive themselves as authentic leaders versus how individual contributors perceive their own workplace leaders' Authentic Leadership traits to be. To ensure non-parametric testing assumptions were not breached the independence of observations included in the statistical analysis was maintained by excluding data provided by leaders of more than 2 people reflecting how they perceived their own workplace leaders' authentic leadership traits to be. In this way, each respondent appeared only in one category.

For the data population as a whole and considering the total ALQ scores of both independent groups (3.33 for leaders versus 2.96 for individual

contributors), the Mann-Whitney U Test highlighted a statistically significant difference between the self-rated perception of authentic leadership traits by leaders of 2 or more people and those perceived by individual contributors.

Authentic Leadership Questionnaire – Rater vs. Self Rater						
Grouping	**N**	**Total ALQ Score**	**Transparency Score**	**Moral/Ethical Score**	**Balanced Processing Score**	**Self-Awareness Score**
Total Leader Population	102	3.33	3.40	3.42	3.26	3.19
Total Individual Contributor Population	350	2.96	3.21	2.96	2.83	2.73
Staff Leaders	28	3.24	3.39	3.33	3.18	3.00
Staff Individual Contributors	68	2.80	3.06	2.86	2.71	2.48
Contractor Leaders	56	3.31	3.34	3.40	3.25	3.24
Contractor Individual Contributors	238	2.98	3.26	2.98	2.84	2.75
Sub-contractor Leaders	18	3.50	3.61	3.61	3.43	3.32
Sub-contractor Individual Contributors	44	3.06	3.20	3.06	2.95	2.95

Table 4.9 ALQ Leader vs. Contributor Outcomes

The Null Hypothesis that the distribution of ALQ total scores would be the same across both independent groups was rejected. With more granular analysis by ALQ feature, the null hypothesis was deduced to be retained for transparency indicating no statistically significant difference in ALQ traits as self-perceived by leaders and as rated by individual contributors. The Null Hypothesis was rejected for internalised moral/ethical, balanced processing and self-awareness, indicating statistically significant differences between the two independent groups, and therefore supporting the Null Hypothesis rejection for the total ALQ score. Further analysis was conducted at the each of the work group levels: Staff, Contractor and Sub-contractor, again utilising

the Mann-Whitney U Test to test for difference between the two independent groups (self-rater and individual-rater) on the continuous ALQ measure. Table 4.10 illustrates the results obtained, identifying where the Null Hypothesis of the same distribution of the ALQ score across both independent groups was either retained or rejected at the 0.05 significance level.

Leader self-perception vs. Individual perception	Total ALQ Score	Transparency Score	Moral/Ethical Score	Balanced Processing Score	Self-Awareness Score
Staff	REJECTED	RETAINED	REJECTED	REJECTED	REJECTED
Contractor	REJECTED	RETAINED	REJECTED	REJECTED	REJECTED
Subcontractor	REJECTED	REJECTED	REJECTED	REJECTED	REJECTED

Table 4.10 ALQ Leader vs Individual ALQ Perception Outcomes

The Null Hypothesis was rejected in all cases except for the transparency feature for the Staff and Contractor leadership groups. For all work groups the ALQ scores obtained, whether total or at the feature level were greater when self-perceived by leaders of 2 or more people than when rated by individual contributors. It was concluded from the analysis that the leaders perceived themselves to be better authentic leaders than their followers perceive them to be. This statistically significant difference represented potential improvement opportunity for both leaders and followers.

To complete the analysis, a Kruskal-Wallis Test (outcome illustrated in Table 4.11) was conducted to compare the Total ALQ scores from leaders from the three work groups of Staff, Contractor and Sub-contractor. The Null Hypothesis that the distribution of Total ALQ score would be the same across each leadership group was retained; no statistically significant difference was detected between the three categories of leadership grouping.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of ALQ Total is the same across categories of Work Group.	Independent-Samples Kruskal-Wallis Test	.059	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .050.

Table 4.11 ALQ Leader Self-Rater Scores Staff, Contractor, Sub-contractor

Consistently across each of the three work groups, leaders of two or more people considered themselves to be more authentic in leadership characteristics than their followers perceived (and rated them) to be.

4.2.5 Safety Climate Tool Analysis

The second data collection instrument in the Offshore Workforce Safety Study questionnaire was the Safety Climate Tool (SCT). Figure 4.7 displays a radar plot of the asset SCT scores, depicting an apparent near parity between the seven assets.

Following more granular analysis, Table 4.12 exhibits total SCT scores by asset. An independent-Samples Kruskal Wallis test was conducted with a Null Hypothesis stating that the distribution of total SCT scores obtained from the full instrument would be the same across each of the seven assets at the 0.05 significance level.

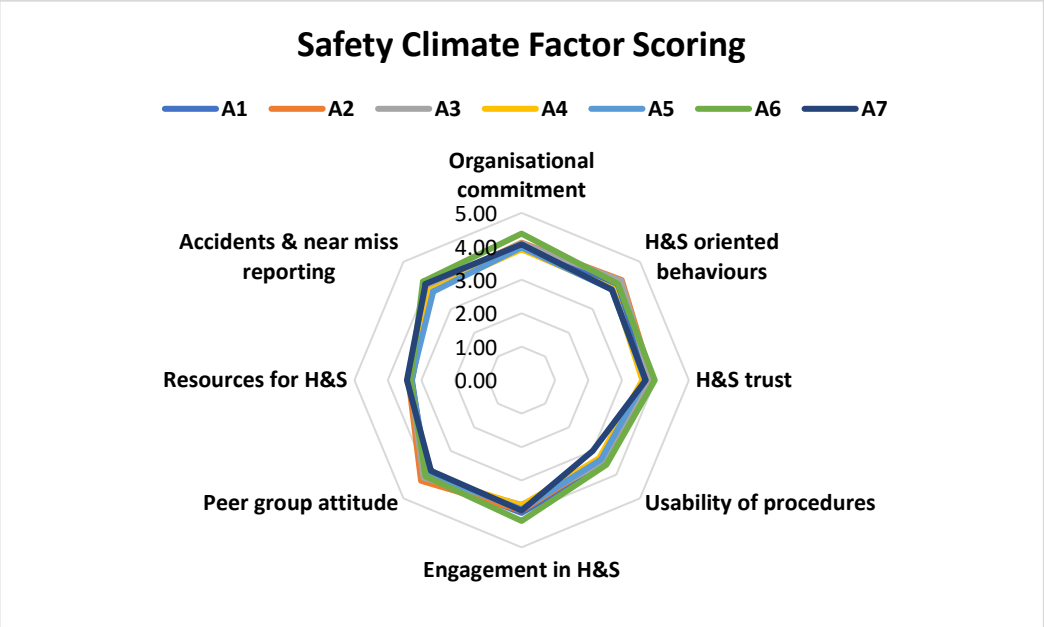

Figure 4.7 Safety Climate Factor Scores by Asset

The Null Hypothesis was retained therefore no statistically significant difference was noted between the total SCT scores recorded for each asset. This may be considered as potential confirmation of the consistent application of the Operating company's safety message '*Nothing is so urgent or important that we cannot take the time to do it safely'* plus the communicated safety

expectations of '*Always Professional, Always in Control, every work site, every task, every day'.*

Asset	N	Average SCT Score	Total SCT %	Lowest Score	Highest Score
A1	46	30.42	76.05%	20.79	37.03
A2	48	31.12	77.80%	22.40	40.01
A3	41	30.79	76.98%	23.38	37.36
A4	95	29.58	73.95%	19.47	37.53
A5	168	29.72	74.30%	18.46	37.63
A6	12	31.77	79.42%	27.43	36.09
A7	42	29.82	74.55%	17.85	37.58

Table 4.12 SCT Scores by Asset

Utilising the Health and Safety Laboratory (HSL) performance groupings, as developers of the SCT (Healey et al., 2012), provides for Poor (<35%), Average (≥35% to <65%), Good (≥65% to <90%), and Excellent (≥90%) groupings for the SCT scoring for the seven assets. From the research population it was determined that in addition to there being no statistically significant difference between asset SCT scores, all assets existed in the 'Good' category. Improvement opportunities were highlighted by the analysis through future actions aimed at raising the scores from the 'Good' to 'Excellent' though the asset portfolio. This would represent a key leading metric for inclusion in a safety strategy balanced scorecard.

Focusing in the eight individual features of the SCT, Table 4.13 illustrates the tabulated scores for each asset, indicating where the Null Hypothesis of same distribution of the SCT scores is the same across each asset was retained or rejected through the Independent-Samples Kruskal-Wallis test at the 0.50 significance level. From the non-parametric statistical analysis conducted, the Null Hypothesis was retained for Safety Climate Factor 1, *Organisational commitment*, demonstrating no significant statistical difference between the seven assets for this SCT feature. All results for this feature scored in the HSL's 'Good' grouping. For Safety Climate Factor 2, *Health and safety oriented behaviours* the Null Hypothesis was rejected demonstrating a statistically significant difference between the seven assets.

	A1	A2	A3	A4	A5	A6	A7	Null Hypothesis
Organisational commitment	4.02	4.11	4.09	3.91	3.97	4.38	4.06	**Retain**
H&S oriented behaviours	4.01	4.23	4.21	3.87	3.83	4.07	3.82	**Reject**
H&S trust	3.70	3.90	3.86	3.61	3.69	3.98	3.71	**Retain**
Usability of procedures	3.54	3.40	3.47	3.29	3.36	3.58	3.00	**Reject**
Engagement in H&S	3.97	3.90	3.73	3.75	3.86	4.21	3.90	**Retain**
Peer group attitude	4.03	4.26	4.14	4.02	3.97	4.06	3.83	**Retain**
Resources for H&S	3.28	3.38	3.33	3.31	3.30	3.32	3.43	**Retain**
Accidents & near miss reporting	3.87	3.94	3.96	3.82	3.74	4.17	4.07	**Reject**
Total SCT Score	**30.42**	**31.12**	**30.79**	**29.58**	**29.72**	**31.77**	**29.82**	
%	**76.05**	**77.80**	**76.98**	**73.95**	**74.30**	**79.42**	**74.55**	

Table 4.13 SCT Scores by Asset and SCT Feature

All SCT feature scores were in the 'Good' grouping, the lowest feature scores obtained from asset A7 (3.82 – 76.40%), A5 (3.83 – 76.60%) and A4 (3.87 – 77.40%). The Null Hypothesis was retained for Safety Climate Factor 3, *Health and safety trust* with all feature scores achieving 'Good' grouping status. Safety Climate Factor 4, *Usability of* procedures had the Null Hypothesis rejected with the lowest scores coming from asset A7 (3.00 – 60.00%), asset A4 (3.29 – 65.80%), and asset A5 (3.36 – 67.20%). The result achieved for Usability of procedures on asset A7 was in the 'Average' grouping as per the HSL categorisation and therefore identified as an improvement opportunity. Considering *Engagement in health and safety,* Safety Climate Factor 5, the Null Hypothesis was retained as it was for Safety Climate Factor 6, *Peer group attitude* and Safety Climate Factor 7, *Resources for health and safety.* For these three features, the scoring attained at each asset was in the 'Good' categorisation. For the final Safety Climate Factor feature, *Accidents and near miss reporting,* The Null Hypothesis was rejected with the lowest scores coming from asset A5 (3.74 – 74.80%), Asset A4 (3.82 – 76.40%) and Asset A1 (3.87 – 77.40%). Despite the Null Hypothesis

rejection for the eighth feature of the SCT, all asset scores achieved were in the 'Good' grouping.

Analysing the SCT results by workforce grouping was also completed utilising the Independent-Samples Kruskal-Wallis test at the 0.50 significance level and Table 4.14 displays the results outcome. The complete set of SCT feature scores recorded across the three groups (Operator personnel, Contractor personnel, and Sub-contractor personnel) were in the 'Good' grouping according to the HSL classification. The Null Hypothesis for the Null same distribution of the SCT feature scores being the same across each Work Group at the 0.50 significance level was retained for six of the SCT features. However, it was rejected for two SCT features, *Peer group attitude* and *Accident & near miss reporting.* For *Peer group attitude* the lowest score came from Sub-contractor personnel (3.97 – 79.40%), an overall 'Good' rating. For *Accident & near miss reporting* the lowest score also came from Sub-contractor personnel (3.78 – 75.60%), also a 'Good' rating.

	Operator	Contractor	Sub-contractor	Null Hypothesis
Organisational commitment	3.97	4.00	4.10	**Retain**
H&S oriented behaviours	4.00	3.95	4.02	**Retain**
H&S trust	3.79	3.71	3.66	**Retain**
Usability of procedures	3.24	3.35	3.36	**Retain**
Engagement in H&S	3.83	3.84	3.86	**Retain**
Peer group attitude	4.08	4.05	3.97	**Reject**
Resources for H&S	3.27	3.34	3.28	**Retain**
Accidents & near miss reporting	4.10	3.84	3.78	**Reject**
Total SCT Score	**30.28**	**30.08**	**30.03**	
%	**75.70**	**75.20**	**75.08**	

Table 4.14 SCT Feature Scores by Work Group

The SCT feature scores recorded by work role, leader of 2 or more people versus individual contributors were similarly analysed utilising the Independent-Samples Mann-Whitney U Test at the 0.50 significance level. Table 4.15 presents the analysis outcome. From the analysis it was determined that all SCT scores attained were in the 'Good' grouping according to the HSL classification. At the SCT feature level the Null Hypothesis for the distribution of SCT scores being the same across both categories of contribution was accepted for seven of the eight features, only rejected for *Organisational commitment* where a lower score was obtained from individual contributors (3.96 – 79.20%) versus leaders of 2 or more people (4.14 – 82.80%).

	Leader	Individual	Null Hypothesis
Organisational commitment	4.14	3.96	**Reject**
H&S oriented behaviours	4.04	3.95	**Retain**
H&S trust	3.82	3.69	**Retain**
Usability of procedures	3.40	3.31	**Retain**
Engagement in H&S	3.94	3.81	**Retain**
Peer group attitude	4.13	4.02	**Retain**
Resources for H&S	3.30	3.32	**Retain**
Accidents & near miss reporting	3.96	3.86	**Retain**
Total SCT Score	**30.73**	**29.92**	
%	**76.82**	**73.30**	

Table 4.15 SCT Feature Scores by Leader or Individual Contributor Role

The final SCT analysis conducted considered SCT feature scoring by Offshore Oil & Gas Industry experience. Table 4.16 displays the results achieved through Independent-Samples Kruskal-Wallis test at the 0.50 significance level.

	< 1 year	1 - 3 years	3 - 5 years	5 - 10 years	> 10 years	Null Hypothesis
Organisational commitment	4.36	4.02	3.82	4.04	3.99	**Reject**
H&S oriented behaviours	4.24	3.84	3.84	4.01	3.96	**Retain**
H&S trust	4.01	3.60	3.52	3.75	3.72	**Retain**
Usability of procedures	3.66	3.29	3.23	3.29	3.34	**Retain**
Engagement in H&S	4.33	3.77	3.74	3.82	3.83	**Reject**
Peer group attitude	4.25	3.83	3.71	4.16	4.03	**Retain**
Resources for H&S	3.48	3.34	3.28	3.30	3.32	**Retain**
Accidents & near miss reporting	3.95	3.83	3.71	3.82	3.94	**Retain**
Total SCT Score	**32.28**	**29.52**	**28.85**	**30.19**	**30.13**	
%	**80.70%**	**73.80%**	**72.13%**	**75.48%**	**75.33%**	

Table 4.16 SCT Feature Scores by UK Offshore Oil & Gas Industry Experience

At the SCT feature level the Null Hypothesis for the distribution of SCT scores being the same across all categories of UK Oil & Gas Industry experience was accepted for six of the eight features but rejected for Organisational commitment and Engagement in health and safety where a statistically significant difference was calculated between the five experience length groupings in both SCT features. Despite the Null Hypothesis rejection for those two features, all SCT scores attained met the HSL 'Good' categorisation of ≥65% to <90%.

From the entire SCT statistical analysis there was only one feature, Usability of procedures at asset A7 during the SCT Scores by Asset analysis, where the Null Hypothesis was rejected, and the asset score obtained was 3.00 (60%) and therefore in the HSL classification 'Average' range. All other scores obtained from the data collection instrument were in the 'Good' categorisation.

Overall, the consistent 'Good' SCT score attainment may be considered as confirmation for the effective understanding and implementation of the Operating company's consistently communicated safety message 'Nothing is so urgent or important that we cannot take the time to do it safely' plus the similarly communicated safety expectation of 'Always Professional, Always in Control, every work site, every task, every day'. From the granular analysis conducted there were a total of 32 opportunities for Null Hypothesis of same distribution across the groupings at the 0.05 significance level to be rejected. However, Table 4.16 demonstrates that in 75% of cases (24 out of 32), the Null Hypothesis was retained.

	Retain	Reject
Organisational commitment	2	2
H&S oriented behaviours	3	1
H&S trust	4	0
Usability of procedures	3	1
Engagement in H&S	3	1
Peer group attitude	3	1
Resources for H&S	4	0
Accidents & near miss reporting	2	2

Table 4.17 SCT Feature Score Null Hypothesis Retention vs. Rejection

4.2.6 Psychological Capital Questionnaire Analysis

The final instrument Offshore Workforce Safety Study questionnaire was the Psychological Capital Questionnaire, regarded to be the standard measurement scale to assess psychological capital (PsyCap) within an organisational context (Lorenz et al., 2016).

Psychological Capital Questionnaire						
Grouping	**N**	**Average PCQ Score**	**Average Efficacy Score**	**Average Hope Score**	**Average Resiliency Score**	**Average Optimism Score**
Total Data Population	**452**	**108.28**	**28.32**	**27.15**	**27.11**	**25.72**
Individual Contributor	350	107.76	28.02	27.05	27.18	25.51
Leader of 2 or more	102	110.08	29.33	27.47	26.86	26.41
Total Staff	96	107.60	28.18	26.92	26.73	25.78
Staff Individual Contributors	68	107.16	27.88	26.76	26.82	25.69
Staff Leaders	28	108.68	28.89	27.29	26.50	26.00
Total Contractor	294	108.86	28.46	27.30	27.29	25.81
Contractor Individual Contributors	238	108.16	28.12	27.13	27.33	25.57
Contractor Leaders	56	111.88	29.91	28.00	27.14	26.82
Total Sub-contractors	62	106.60	27.84	26.77	26.81	25.18
Sub-contractor Individual Contributors	44	106.57	27.68	27.05	26.91	24.93
Sub-contractor Leaders	18	106.67	28.22	26.11	26.56	25.78

Table 4.18 Psychological Capital Questionnaire Scoring Results

Table 4.17 presents the PsyCap scoring attained across the data population, considering work group (Operator, Contractor, or Sub-contractor) and role as either a leader of 2 or more people or an individual contributor. Undertaking a statistical analysis of the total Psychological Capital Questionnaire (PCQ) using the Independent-Samples Kruskal-Wallis Test, it was determined that there was no statistical difference between the three workforce groupings of Operator, Contractor and Sub-contractor. The Null Hypothesis that the distribution of the PCQ Total would be the same across all three workforce groupings at the .050 significance level was retained.

Repeating the analysis at the PQC feature level (Efficacy, Hope, Resiliency and Optimism) similarly concluded that there was no statistically significant difference, with the Null Hypothesis of the distribution being the same for each feature across the three workforce groupings at the .050 significance level being accepted in all cases.

Turning to each of the individual work groups, the Mann-Whitney U Test was utilised to examine for possible statistically significant differences between leaders of 2 or more people and individual contributors at both the total PCQ score and individual feature levels. For Operator personnel, the Null Hypothesis of the same distribution of PCQ scores across the leaders and individual contributor were unanimously retained; no statistically significant difference in psychological capital levels between the two groups. For Contractor personnel the Mann-Whitney U Test was repeated. A statistically significant difference was noted for the total PCQ score between the leaders of 2 or more people and individual contributors with the Null Hypothesis of the distribution of PCQ total scores being the same across both work groups at the .050 significance level being rejected. The average score was higher for leaders of 2 or more people (111.88) than for individual contributors (108.16). Further granular analysis was conducted at the PQC feature level where the Null Hypothesis of same distribution of PCQ scores was rejected for the Efficacy and Optimism, but retained for Hope, Resiliency. For both features where the Null Hypothesis was rejected leaders of 2 or more people had higher PCQ feature scores than individual contributors; Efficacy (29.91 versus 28.12) and Optimism (26.82 versus 25.57). Repeating the Mann-Whitney U Test for the two Sub-contractor groups revealed retention of the

Null Hypothesis of same distribution across both work groups at the .050 significance level for the PCQ total score and therefore no statistically significant difference. Likewise, at the PCQ feature level, all Null Hypothesis were retained and demonstrated that there was no statistically significant difference between leaders of 2 or more people and individual contributors within the data population.

Considering psychological capital by length of Oil & Gas Industry experience. Table 4.18 outlines the results obtained from the Workforce Safety Study sample population.

Psychological Capital Questionnaire						
Experience	**N**	**Average PCQ Score**	**Average Efficacy Score**	**Average Hope Score**	**Average Resiliency Score**	**Average Optimism Score**
Total Data Population	**452**	**108.28**	**28.32**	**27.15**	**27.11**	**25.72**
Less than 1-year	20	112.65	28.85	28.45	27.95	27.40
1 to 3 years	21	111.67	29.52	28.10	27.81	26.24
3 to 5 years	33	106.48	27.27	26.85	26.48	25.88
5 – 10 years	112	109.75	28.78	27.52	27.78	25.68
Greater than 10 years	266	107.30	28.11	26.85	26.78	25.54

Table 4.19 Psychological Capital Questionnaire Scoring Results by industry Experience

Utilising the Independent-Samples Kruskal-Wallis Test to test for statistically significant difference across the different experience groups for total PCQ score and at the feature level, the Null Hypothesis for the distribution of PCQ scores to be the same across all experience categories at the .050 significance level was retained in all cases. There was therefore no statistically significant difference in PsyCap levels based on duration of Offshore UK Oil & Gas Industry experience.

4.2.7 Correlation Analysis

Data correlations utilising the Spearman Rank Order Correlation (rho) technique for non-parametric data were conducted across the data population for: SCT and ALQ-Rater scores; SCT and PCQ scores; and ALQ-Rater and PCQ scores. With regard to the strength of the relationship indicated by the correlation coefficient (either negative or positive) Pallant (2016) proposes the following guidelines: small (r = .10 to .29); medium (r = .30 to .49); or large (r = .50 to 1.0). Utilising these guidelines and following the analysis Table 4.19 displays the results obtained for each of the three cases.

Correlations

			SCT	ALQ Rater
Spearman's rho	SCT	Correlation Coefficient	1.000	.434**
		Sig. (2-tailed)	.	.000
		N	452	452
	ALQ Rater	Correlation Coefficient	.434**	1.000
		Sig. (2-tailed)	.000	.
		N	452	452

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			SCT	PCQ
Spearman's rho	SCT	Correlation Coefficient	1.000	.433**
		Sig. (2-tailed)	.	.000
		N	452	452
	PCQ	Correlation Coefficient	.433**	1.000
		Sig. (2-tailed)	.000	.
		N	452	452

**. Correlation is significant at the 0.01 level (2-tailed).

Correlations

			ALQ-Rater	PCQ
Spearman's rho	ALQ-Rater	Correlation Coefficient	1.000	.355**
		Sig. (2-tailed)	.	.000
		N	452	452
	PCQ	Correlation Coefficient	.355**	1.000
		Sig. (2-tailed)	.000	.
		N	452	452

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.20 Correlation Coefficients

For SCT and ALQ-Rater scores the correlation was positive-medium, with a r value of .434 in both cases. The stronger the SCT the stronger the ALQ-Rater perception and vice versa. For SCT and PCQ scores the correlation was also positive-medium, with a calculated r value of .433 in both cases. The stronger the SCT the stronger the PCQ assessment value and vice versa. Similarly, the

correlation between PCQ and ALQ was calculated to be positive-medium reflecting the higher the ALQ-Rater perception the higher the PCQ assessment value and vice versa. For the latter correlation, the r value was calculated to be .355 indicating that although positive, the correlation was weaker between ALQ-Rater and PCQ than between SCT and ALQ-Rater (r = .434) plus between SCT and PCQ (r = .433). It was therefore concluded that both authentic leadership and psychological capital, individually, exert a stronger positive influence on safety climate across the Operators value chain than they were observed to exert upon each other.

4.3 CHAPTER SUMMARY

This chapter reviewed the primary research findings obtained through the methodological triangulation approach deployed and sought to place into context the outcomes delivered through the qualitative semi-structured interviews and subsequent content analysis, plus the quantitative Offshore Safety Survey instruments and consequential non-parametric statistical analysis. The following chapter will consider and present to the reader the research findings, analysis outcomes and conclusions within the context of the research aim, the established research questions, and research objectives by way of sense-making and corresponding research questions developed to fulfil the aim and objectives.

*** *** ***

CHAPTER 5
DISCUSSION AND SENSE MAKING

5.0 INTRODUCTION

This chapter presents a discussion and evaluation of the research findings obtained from the adopted pragmatic research philosophy and the established triangulation methodology, sometimes known as mixed method research. For the readers benefit, the research findings will be considered in context with the key literature review features and emergent themes to deliver implications for Health and Safety practice plus original contribution to the body of safety science knowledge. Additionally, the findings will be considered with due regard as to how they substantiated, were analogous with, or differed from the critically reviewed literature conclusions and synthesis. Finally, limitations experienced with data and findings will be presented.

Chapter One outlined that the UK Oil & Gas Piper 25 Conference held during June 2013 to commemorate the 25th anniversary of the piper Alpha disaster, presented a review of the Cullen Recommendations following the disaster enquiry, and questioned current relevance. The conclusion was that in the UK Offshore Oil & Gas Industry, accidents and incidents still occur for 'old' reasons. To meet these challenges, it was stressed by the UK Health and Safety Regulator as being essential for organisations working in the industry to develop and implement appropriate business strategies, supported by effective leadership. Consequently, the aim of the research was established to be:

'*Explore the ways in which organisational typology, strategy, leadership, and psychological forces contribute to safety performance'.*

When the research was significantly underway, a Safety 30 industry conference held during June 2018 to commemorate the 30th anniversary of the Piper Alpha disaster. Lord Cullen presented an address containing a stern reminder of the dangers of complacency, particularly the dangers associated with not recognising or effectively acting upon warning signals. The examples highlighted included: Texas City Oil Refinery, 2005; Buncefield Oil Storage

Depot, 2005; and Deepwater Horizon, 2010. These disasters were multi-faceted rather than purely engineering and technical in root cause, each giving rise to incident investigations, reports and academic studies illustrating [amongst other considerations] Human Factors (HF) plus social interactions as contributing factors. The Safety 30 conference served to reinforce the originality and continued relevance of the established research aim. The consideration of Safety 30 implied that the conclusions of Hackitt (2013) from the Piper 25 Conference had not been fully acted upon; there remained propensity for further UK Offshore Oil & Gas Industry disasters. This propensity for disaster remains despite the industry's improving safety performance trends over the past two decades as documented in section 1.1.3: Fatal Injuries Offshore; Over-Seven-Day and Specified Injury Rate per 100,00 Workers; and the Number of Process Hydrocarbon Releases Offshore.

Recognising the paucity of research literature considering HF as an aligned and integral element of business and/or safety strategy and when taken with currently expressed concerns regarding ageing assets, and continued safety issues within the industry, there was genuine potential identified for topicality and originality of purpose in the research undertaking. Cognisant of the established research aim, the subsequently generated six general focus research questions were used to direct the literature review and provide the basis for research objective development, leading to greater specificity in the research to be undertaken. The research questions defined in section 7.0 of chapter 1 were:

1. What are the organisational typologies displayed by value chain organisations 'Operator', 'Contractor', and Sub-contractor'?

2. To what extent is safety strategy, with HF content, included as an aligned element of organisational business strategy for the differing organisational typologies?

3. What is the relationship between workforce psychological capital and organisational typology within value chain organisations?

4. What is the relationship between organisational typology and safety leadership style within value chain organisations?

5. What is the relationship between organisational typology and perceived workforce safety climate at offshore assets involved in Exploration, Operations, Asset Life Extension and Decommissioning?

6. What effect does the Operator company safety message(s) have in creating alignment between all involved parties, irrespective of typology, to deliver acceptable safety performance?

The six established research questions were subsequently operationalised into five research objectives as defined in section 8.0 of chapter 1 to provide clear and specific statements identifying the intended accomplishments of the research undertaken:

1. To determine the extent of the influence exerted by organisational typology on the construction of safety strategy as an aligned element of overall organisational strategy. (From research question 1).

2. To establish whether the psychological forces component of Human Factors is embraced within constructed safety strategies, considering psychological capital as an antecedent of safety focused behaviour. (From research questions 2 and 3).

3. To describe the organisational typology associations with specific styles of safety leadership at the operational level on offshore assets during the lifecycle phases. (From research question 4).

4. Determine how the preceding three aspects of safety strategy implementation combine to produce individual asset safety climate profiles. (From research question 5)

5. Determine whether safety performance as reflected through safety climate perception is driven by individual organisational typologies or by the Operator company overarching safety message. (From research question 6).

Upon completion of data collection and analysis, the research aim, questions, and objectives provided a framework for data outcome discussions and formulation of data-driven conclusions, plus guidance for the thesis write-up.

The research methodology utilised for the study was mixed methods, where the findings from a study may be enhanced by using more than one way of measuring a concept. The first strand of data collection utilised the use of qualitative semi-structured interviews conducted with onshore managers to assess and identify: the onshore consideration of organisational typology across a typical Offshore Oil & Gas Industry value chain; formalisation of safety strategy; considerations of workforce psychological capital; safety leadership; and safety climate as a predictor of safety performance. Secondly, and in parallel, an Offshore Workforce Safety Study was deployed to gather quantitative data from the offshore workforce addressing key areas of focus derived from critical literature review: perceptions of authentic leadership traits; safety climate on the individually sampled offshore assets; and workforce psychological capital. Findings from the semi-structured interviews were subjected to manual content analysis; findings from the Offshore Workforce Safety Study were analysed utilising non-parametric statistical methods.

5.1 SEMI-STRUCTURED INTERVIEW CONTENT FINDINGS SUMMARY

From Operator interviews, 76% of interviewees identified their organisation to be most closely aligned with a Defender-type organisation with the remainder falling between Defender and Prospector-type organisations. For Contractor personnel, 74% identified with a Prospector-type organisation with the remainder at the intersection of Prospector and Defender. For Sub-contractors, the most diverse group in size and complexity, 58% identified as Analyzer-type organisations, 27% as Reactor-type, and the remainder at the intersection between Analyzer and Reactor.

Considering Safety Strategy none of the Operator, Contractor or Sub-contractor interviews could identify their organisations as having a documented safety strategy. The Operator and Contractor organisations demonstrated some similarity in having clearly established safety goals and objectives, implemented, and monitored through established management

system arrangements. Lagging performance measures were maintained on a business scorecard. In the case of the Operator, the goals and objectives were aligned with the global corporate organisation and the safety portion of the business scorecard contained both leading and lagging safety performance measures. Sub-contractor displayed less awareness around safety strategy, while frequently referring to independent third-party safety management certification (to BS OHSAS 18001:2007 or ISO 45001:2018). Sub-contractor personnel from micro-businesses and Limited Company Sub-contractors confirmed that their organisations and no safety strategy established, document, or implemented; employed based on their personal competencies they were reliant on the Operator company for safety strategy and direction. Strategy was frequently referred to as being reflected in the Operators safety message 'Nothing is so urgent or important that we cannot take the time to do it safely'.

Focusing on workforce psychological capital, across all three grouping there was a consistent message that on offshore assets following the Operator control of work arrangements was an imperative; failure to do so may have adverse consequences for transgressors. While no specific psychological capital development or reinforcing activities were identified through the semi-structured interview process, all groups referred to the importance of: staying within the Safety Triangle (Policies & procedures / Training & Competency / The Law); exercising the Stop Work Authority without fear of negative consequences; plus involvement in the Safety Observation and Conversation programs. All three elements established to prevent inadvertent and adverse consequences as manifest through workplace accidents.

From a Leadership perspective both the Operator and Contractor interviewees confirmed the presence of leadership training programs. However, given that safety was said to be an organisational value, safety was integral to leadership training rather than being a stand-alone training programme itself. For the Operator company the described leadership competencies appeared to reflect elements of authentic leadership. Sub-contractor interviewees confirmed that they were primarily selected based on their competence levels as reflected through education, training, skills, and experience. Leadership

training was not [apparently] as well developed as for the Operator and Contractor organisations.

The final focus area of the semi-structured interview process was Safety Climate. Both Operator and Contractor interviews referred to their own organisations' history of strong and positive safety culture. When asked to describe safety culture there were a variety of answers presented, including management certification (to BS OHSAS 18001:2007 or ISO 45001:2018). Sub-contractor personnel from micro-businesses and Limited Company Sub-contractors confirmed that their organisations and no safety strategy established, document, or implemented; employed based on their personal competencies they were reliant on the Operator company for safety strategy and direction. Strategy was frequently referred to as being reflected in the Operators safety message 'Nothing is so urgent or important that we cannot take the time to do it safely'.

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The final focus area of the semi-structured interview process was Safety Climate. Both Operator and Contractor interviews referred to their own organisations' history of strong and positive safety culture. When asked to describe safety culture there were a variety of answers presented, including 'it's just the way the company has always done things, safely'. There was frequent reference by Operator personnel to the clearly communicated organisational safety message. Personnel expressed a lack of understanding of the difference between culture and climate, the latter not being part of the organisational vocabulary. No safety climate measures had been made in either the Operator or Contractor organisations whose personnel had participated in the semi-structured interview process. Sub-contractor personnel confirmed no awareness of safety climate measurements being taken in their own organisations.

5.2 NON-PARAMETRIC STATISTICAL ANALYSIS OF OFFSHORE WORKER SAFETY STUDY QUESTIONNAIRE FINDINGS SUMMARY

Importantly for data reliability, the Cronbach's Alpha calculations for all three data gathering instruments and incorporating twenty separate scales confirmed consistency of measurement across the concepts being measured: Authentic Leadership (ALQ); Safety Climate (SCT); and Psychological Capital (PsyCap).

From the evaluation of Authentic Leadership characteristics, it was determined that obtained ALQ-Rater scores were higher for leaders of 2 or more people than for individual contributors. This was consistent across all work groups of Operator, Contractor and Sub-contractor and demonstrated that leaders perceived stronger Authentic Leadership traits in their own leaders than followers do in theirs. Further, and from comparing leader self-rated ALQ scores versus individual (follower) rated ALQ scores leaders perceive themselves to have stronger ALQ traits than their followers perceive of them.

Non-parametric statistical analysis of Safety Climate Tool (SCT) data revealed that there was no statistically significant difference in the total SCT scores across the seven sample offshore assets A1 through A7. Utilising the Health and Safety Laboratory (HSL) performance groupings, as developers of the SCT (Healey et al., 2012), provides for Poor (<35%), Average (≥35% to <65%), Good (≥65% to <90%), and Excellent (≥90%) groupings for the SCT scoring for the seven assets. From the research population it was determined that in addition to there being no statistically significant difference between asset SCT scores, all assets existed in the 'Good' category. That was not concluded to be the perfect, rather it presents an improvement opportunity through the journey from Good to Excellent. Numerous and more granular analysis of SCT scores demonstrated 75% retention of the Null Hypothesis (distribution being the same across all groups in the comparison at the .050 significance level); 24 out of 32 comparative analyses. This was concluded to be confirmation of the Operator organisation clear communication and effective implementation of its safety message 'Nothing is so urgent or important that cannot take the time to do it safely.'

Undertaking non-parametric statistical analysis for the total Psychological Capital Questionnaire (PCQ) demonstrated that there was no statistical difference (at the .050 significance level) between Operator, Contractor or Sub-contractor personnel. An equivalent result was obtained when examining PCQ scores based on experience years in the UK Offshore Oil & Gas Industry. However, a statistically significant difference (at the .050 significance level) was recorded between leaders of 2 or more people and individual contributors from the Contractor group, the former having higher total PCQ.

The final non-parametric statistical analysis conducted on the Workforce Offshore Safety Study data involved correlation. Positive-medium correlation was found disclosed between SCT and ALQ-Rater scores (r = .434), SCT and PCQ scores (r = .433). ALQ and PCQ were disclosed to also have a medium-positive correlation (r = .355). Both ALQ and PCQ were concluded, as antecedents, to exert a positive influence on SCT.

One key conclusion drawn from the research data obtained, both qualitative and quantitative) was that while it was possible to identify the Operator,

Contractor and Sub-contractor organisations within a typical Oil & Gas industry value chain to Miles and Snow (1978) typologies (Defender, Prospector, Analyzer, and Reactor), the typology had little or no influence on measured safety climate offshore assets. The causal factor was identified to be Operator insistence that all control of work systems implemented at the asset level were in accordance with its own established safety management governance, established policies, procedures, and work instructions. This determined that in addition to there being no statistically significant difference between asset SCT scores, all assets existed in the 'Good' category. That was not concluded to be the perfect, rather it presents an improvement opportunity through the journey from Good to Excellent. Numerous and more granular analysis of SCT scores demonstrated 75% retention of the Null Hypothesis (distribution being the same across all groups in the comparison at the .050 significance level); 24 out of 32 comparative analyses. This was concluded to be confirmation of the Operator organisation clear communication and effective implementation of its safety message 'Nothing is so urgent or important that cannot take the time to do it safely.'

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5.3 ORGANISATIONAL TYPOLOGY, SAFETY STRATEGY, AND HUMAN FACTORS SENSE MAKING

The focus areas of organisational typology and safety strategy, both safety performance outcome influencing, was collected through purposive semi-structured interviews conducted onshore. In total, 39 individuals were interviewed from a target of 45 after theoretical saturation had been reached and the researcher considered that sufficient data had been obtained to deliver a reasonably rigorous claim of true representation (Glaser, 1992; Strauss and Corbin, 1998). The outcome of the purposive sampling exercise was considered appropriately aligned with the conclusions of Ritchie et al. (2003: 84) who noted that qualitative samples are often under 50. The sample population comprised representatives from middle and senior management from Operator, Contractor and Sub-contractor organisations within the Operators value chain. All interviewees had personnel working on offshore assets for or on behalf of the Operator. They all had engineering or science backgrounds; none were professional economists or strategists.

Utilising the typology definitions from Miles and Snow (1978) and from the Operator responses provided on the anonymous marking grid an organisational typology pattern emerged across the Operator value chain. 76% of interviewees identified with a Defender-type organisation. According to Miles and Snow (*ibid*) Defenders are organisations that operate in an environment with narrow product-market domains; in the case of the

organisation being researched, oil and gas, with no diversification into other energy market domains such as renewables. Given the narrow focus, such an organisation infrequently requires major adjustment to technology, structure, or operational processes; the latter being centred around compliance with The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015. The primary attention of a Defender-type organisation is with improving efficiency of the existing operations given that the primary assets of an Exploration and Production (E&P) company are its economically viable hydrocarbon reserves (Howard and Harp, 2009), essential to sustaining market position. The remaining 24% identified as falling between Defender and Prospector-type organisations. Prospectors are defined by Miles and Snow (*ibid*) to be almost continually searching for market opportunities, regularly experimenting with potential responses to emerging environmental trends. Due to the strong concern for product and market innovation, Prospector organisations are usually not entirely efficient. It may have been the turbulence in the UK Offshore Oil & Gas industry, the regular re-organisation and frequent change the Operator organisation experienced since the oil price downturn of 2015 (Figure 5.1) that resulted in the between Defender and Prospector selection from some interviewees.

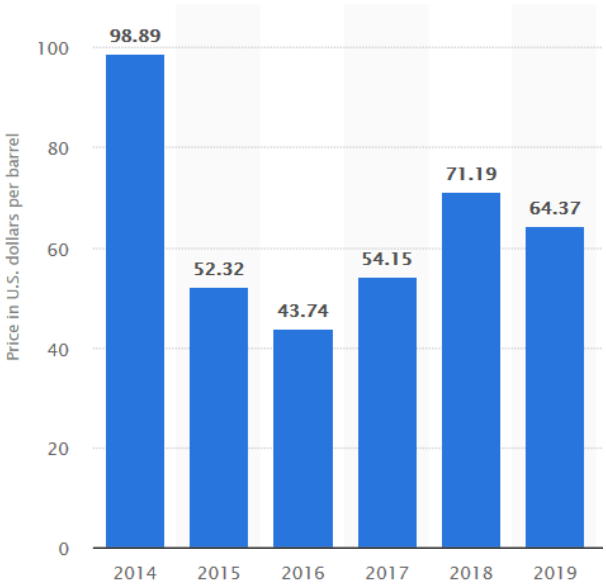

Figure 5.1 Crude Oil Prices: Brent 2014-2019 (based upon Statista 2019)

The oil price downturn was a significant environmental condition requiring response and adjustment to avoid extinction.

If the between Defender and Prospector selection was not oil price driven, it was an entirely plausible perception given that Miles and Snow (1978: 30) acknowledge that any one typology is unlikely to encompass every form of organisational behaviour given that that the world of organisations is "*too changeable and complex to permit such a claim"*.

Operator interviewees declared no awareness of a single documented safety strategy however, it was unanimously confirmed that the Operator had clearly documented safety goals and performance targets that were confirmed, monitored, and regularly adjusted, and formally re-established on an annual basis. The apparent lack of a documented safety strategy, a *'1-page Safety Plan'* was not considered to be problematic, rather it confirmed the position concluded in seminal strategy and strategic content research that in organisational settings there may not be one plan, ploy, search for position, pattern or perspective but many (formal and informal) among key influencers each presenting a variety of plans, positions, and perspectives (Mintzberg, 1987; Hax, 1990; Moncrieff, 1999; Peattie, 1993). Safety measures, both leading and lagging were stated to be included in the Operators business scorecard, which in turn, was aligned with the corporate and global organisation. The business scorecard was central to the organisations (global) variable incentive bonus scheme with safety performance as a key component (Kaplan and Norton, 1992; 1996; 2006). Safety performance metrics were said to be under continual review but there was a formal quarterly Safety Assurance Board process established for the UK President and Top Management to review performance and make strategic adjustments as required. Interviewees considered safety strategy to be effectively communicated through goals and objectives and executed through safety management governance documented in the Operating Management System. Key in the communication of safety strategy was stated to be two statements. Firstly, that '*No job is so urgent or important that we can't take time to do it safely'.* Secondly, the need to be '*Always Professional, Always in Control, every work site, every task, every day'.* These messages were said to be consistent and highly visible both onshore and offshore.

Vogt et al. (2010) considered that a balanced scorecard approach to Human Factors (HF) within safety strategy would provide a means of identifying

enablers of safety, plus a means of systematically allocating resources to them. From Operator interviewees it was confirmed that HF metrics were not included as either leading or lagging metrics within the safety element of the business scorecard. With this lack of formal inclusion in the business scorecard, entirely possible with the modified Business Scorecard (Kaplan and Norton, 2006), it was concluded that Operator's capability for enhanced delivery of business benefit through increased efficiency and the prevention of accidents in the workplace would be reduced. HF inclusion within the documented Operating Management System, was said to be at a high rather than detailed level. HF was also recognised within the Operator accident investigation procedure regarding the identification of human causes of accidents and incidents. The procedure was said to require HF analysis as an important part of the investigation process, recognising that human behaviour should be considered alongside technical causal factors during an investigation. None of the interviewees recognised the dynamics of social interaction to be an element of HF with the ability to defeat safety barriers (Storseth et al., 2014) resulting in accident, incident and MAH. While behaviours were considered as part of accident investigation, psychological or social dynamic issues were stated not to be considered.

Interviewees from Contractor organisations predominantly (74%) aligned with the Prospector-type organisation (Miles and Snow, 1978) with 13% identifying a between Prospector and Defender and 13% as Defender-type. As stated previously, Defenders are organisations that operate in an environment with narrow product-market domains while Prospectors are almost continually searching for market opportunities, regularly experimenting with potential responses to emerging environmental trends. Unlike the Operator organisation operating in a single product-market domain (hydrocarbons) all the Contractor organisations represented through semi-structured interview worked across multiple industrial and service sectors such as: chemicals and refining; mining and minerals; civil engineering and infrastructure; power generation. In addition to holding diverse portfolios, several of the Contractor organisations worked on an international basis, more than rivalling the Operator organisation in terms of personnel employed and market capitalisation. The conclusion drawn was the diversity of product-market domains influenced the typology identification by interviewees,

skewing the selection towards Prospector. Again, for those interviewees selecting an in between Prospector and Defender position Miles and Snow (1978) acknowledged that any one typology is unlikely to encompass every form of organisational behaviour. A similar perspective was provided from Contractor interviewees about safety strategy as had been presented by interviewees from the Operator organisation. Safety was clearly understood to be a strong organisational value in all cases but [like the Operator] none of the interviewees recalled seeing a stand-alone safety strategy document within their own organisations. Rather safety strategy was communicated through plans, goals, targets, and established safety management systems (Mintzberg, 1987; Hax, 1990; Peattie, 1993; and Moncrieff, 1999;). The existence of safety performance as part of a balanced scorecard for each of the organisation represented by interviewees was acknowledged. However, the safety measurements included within the scorecard (verified through review of Company Annual Reports) were lagging in nature. For example, Lost Time Injury (LTI), and Recordable Injury (RI) Frequency rates. In utilising a more traditional balanced scorecard (Kaplan and Norton, 1992; 1996) with limited (and only lagging) safety performance metrics the strategic performance measurement system may be reduced in effectiveness as the organisations are confronted with unpredictable and unstable environmental conditions (Stacey, 1995; Combe and Botschen, 2001; Casertano, 2013; and Ermida 2014), typified by the recent turbulent oil prices as depicted in Figure 5.1. All interviewees confirmed that the Operator safety strategy messages of '*No job is so urgent or important that we can't take time to do it safely'.* Secondly, the need to be '*Always Professional, Always in Control, every work site, every task, every day'* resonated through the contractual engagement, both onshore and offshore. Specifically, it was noted that at the offshore asset level, the Operator control of work arrangements take primacy.

All Contractor personnel interviewed confirmed that there was no specific mention of Human Factors within strategy or on the business scorecard. The Contractor organisations retained a similar perspective to HF within accident investigations as the Operator organisation. Similarly, the dynamics of social interaction and psychological forces were not recognised to be an element of

HF with the ability to defeat safety barriers resulting in accident, incident and MAH events.

Considering organisational typology within the Sub-contractor group, 58% of interviewees identified with an Analyzer-type organisation, 27% a Reactor-type and the remaining 15% falling between the Analyzer and Reactor typologies (Miles and Snow, 1978). The researcher considered the identification outcome to be reflective of organisational diversity and broad spectrum of organisational specialisms that included small and medium sized enterprises (SME) with fewer than 250-employees, micro-businesses with fewer than 9-employees, through to self-employed personnel working on a sub-contract basis through a Limited Company status. From Sub-contractor personnel interviewed there was less awareness around safety strategy. Interviewees from micro-business and Limited Company Sub-contractors confirmed that their organisations had no safety strategy established, documented, and communicated but all were stated to have safety performance goals and targets. These organisations were concluded to likely have reduced sustainable competitive advantage due to simpler or less developed strategic capabilities (Barney, 1991). All but the micro-businesses and Limited Company Sub-contractors had documented safety management systems to implement safety strategy, potentially reducing their sustainable competitive advantage further. Working entirely for Operator or Contract organisations they were engaged on the basis of their technical competencies and the most important thing was to follow the safety management governance and control of work arrangements provided by the organisation that they were working for. In a similar manner to Contractor personnel, interviewees presented with a strong awareness of Operator safety strategy messages of '*No job is so urgent or important that we can't take time to do it safely'.* Secondly, the need to be '*Always Professional, Always in Control, every work site, every task, every day'* resonated through the contractual engagement, both onshore and offshore. Again, it was noted that at the offshore asset level, the Operator control of work arrangements take primacy.

Within the Sub-contractor interview group, the majority of interviewees confirmed that their awareness and knowledge of Human Factors had been gained from experiences working for the Operator organisation. None had

any HF content to business scorecards (in the event they had been established). The means of avoiding normalisation of warnings, consensus mode decision making, confirmation bias, and group think was confirmed by most interviewees to be achieved through following Operator control of work arrangements and staying inside the safety triangle.

In conclusion for Organisational Typology and Safety Strategy, the Operator organisation interviewees strongly aligned (76%) alignment with the Defender typology. The interviewees presented a clear indication of safety strategy, not documented as a single item but rather presented as a series of plans, positions, and perspectives. A balanced scorecard was said to utilised within the UK organisation aligned the corporate entity, with safety performance metrics (both leading and lagging) as a key component of the construct along with ongoing Top Management review. Safety performance was seen to be considered as a key strategic driver with determined propensity for providing competitive advantage. For Contractor organisations there was a clear alignment with Prospector typology (74%). As per the Operator organisation there was a clear indication of safety strategy presented as a series of plans, positions, and perspectives. Although safety performance measures were said to be included in a balanced scorecard they were only lagging in nature. Thus, there was potential for reduced effectiveness in determining strategy implementation effectiveness during periods of unstable environmental conditions as typified by the sustained low market oil price. Finally, for Sub-contractor organisations it was concluded that strategy capabilities were divided predominantly between 58% of interviewees identified with an Analyzer-type organisation (58%) and Reactor-type (27%). From semi-structured interview responses, it was clear that as the progression was followed from SME Sub-contractors through to micro-business and self-employed persons the typology identification travelled from Analyzer to Reactor; strategy formalisation and establishment appeared to reduce accordingly along with, consequently, reduced sustainable strategic capabilities. Through lack of developed safety strategy, combined with a lack of identification of HF as a means of preventing accident and incident, the Sub-contractor organisations presented with reduced ability of delivering HF competitive advantage to the Operator value chain (Vogt et al., 2010).

The most significant conclusion from semi-structured interviews considering organisational typology and safety strategy was that for Contractor and Sub-contractor organisations, their typology has little or no impact on safety management and safety performance on the Operator assets given confirmation that all control of work on the assets is under Operator control. Contractor and Sub-contractor personnel are expected to be 100% compliant with the Operator's control of work requirements. Although Contractor and Sub-contractor organisations are typically subject to an evaluation and selection process (normally risk-based), HSE Auditor interviewed confirmed that audits conducted were: safety management system standard based, for example ISO 45001:2018; compliance orientated; strategy reviews were restricted to goals, objectives; targets; and plans to achieve them. Further, HF content was restricted to competence assessment based on education, training, skills, and experience; there was no HF consideration beyond a [biased] technical component. Industry established guidance does little to discourage such practices, for example the Tender Efficiency Framework (OGUK, 2017), and the NORSOK Standards S-WA-006 HSE-evaluation of contractors' standard.

5.4 PSYCHOLOGICAL CAPITAL SENSE MAKING

Results from semi-structured interviews led to the conclusion that the typical UK Offshore Oil & Gas Operator value chain relied heavily on the traditional sources of competitive advantage, namely financial, structural, and physical, plus technological capital (Luthans and Youssef, 2004). From an Operator, Contractor, or Sub-contractor perspective prevention of accidents and Major Accident Hazard (MAH) events is through effective control of work systems being deployed and complied with on offshore assets. The Operator organisation establishes control of work systems and everyone working on the assets must rigidly comply, whether Operator, Contractor or Sub-contractor personnel. Reference was frequently made by all value chain group interviewees to the to follow the Safety Triangle and work within the Law, follow correct policies and procedures (the Operator control of work arrangements), and to work within their own level of competence and training. Some support is provided through OIM 'Green Hat' inductions talks to fist time arrivals onboard an asset; here the Operator organisation safety

message and expectations are delivered by senior management offshore. In the workplace the additional expectation is for the workforce to help themselves and others '*stay safe*' by exerting the Stop Work Authority plus engage in Safety Conversation and Observation Card process.

At best it was deduced from semi-structured interview that there was some element of Human Capital Management (Luthans and Youssef, 2004) taking place across the Defender, Prospector, and Analyzer organisation types typologies. The larger the organisational entity (Operator and Contractor) the more evidence was presented at interview. For example, Human Resource functions to coordinate selection processes, training and development, and tacit knowledge building through competence assurance activity. Towards the micro-business and self-employed individuals (predominantly identifying as Reactor-type organisations) there appeared to be little Human Capital Management with interviewees confirming they were selected for working assignments based on their competence levels reflected through education, training, skills, and experience. There was also some evidence of Social Capital Management particularly with Defender and Prospector-type organisations reflected through open communication channels and cross-functional teams. On offshore assets, all persons onboard are encouraged to participate in Stop Work Authority without fear of adverse consequences; also, participation in the safety Conversation and Observation Card process. However, the work-life balance aspect of Social Capital Management (Luthans and Youssef, *ibid*) was not examined within the research undertaken. From critical literature review it was understood that it is possible to distinguish psychological capital (PsyCap) from other forms of people related capital (Lorenz et al., 2016). Human Capital as mentioned relates to a person's stock holding of knowledge skills and experience that may be enhanced through experience plus investment in training; this investment was detected. Social Capital is represented in the aggregate of actual or potential resources connected to the holding of a sustainable network of relationships was also detected from interview. Psychological capital (Luthans and Youssef-Morgan, 2017) with its component elements of efficacy, hope, self- resilience, and optimism did not appear to be subject to management by any of the typologies identified within the value chain, with one exception. Management of the PsyCap feature of Hope includes goal setting. All interviewees except

self-employed personnel operating as Sub-contractors confirmed participation in annual goal setting processes. The HSE Auditors in both Auditor and Contractor semi-structured interviews confirmed that when conducting audits internally, or externally on supply chain organisations, PsyCap, psychological forces (position, pressure, power) and the dynamics of social interaction had never been considered when auditing topics such hazard analysis, hazard identification, risk assessment and risk control.

There is no established Low/Medium/High scoring mechanism established for the Psychological Capital Questionnaire as included in the Offshore Workforce Safety Study. As per the instructions received with the Academic Licence each feature (subscale: efficacy; hope; resilience; and optimism) is calculated by the mean of all the items in the subscale. The overall PsyCap score was to be calculated by taking the mean of all the items in the PCQ. Three groups of non-parametric statistical analysis were conducted to search for statistical difference in PCQ scores. Firstly, it was calculated that there was no statistically significant difference in total PCQ level between the three workforce groupings of Operator, Contractor and Sub-contractor. The workforce grouping analysis was repeated to provide granularity at the feature level (efficacy; hope; resilience; and optimism) and, again, no statistically significant difference was calculated.

Statistical analysis for differences between leaders of 2 or more people versus individual contributors within each of the work groups. No difference was recorded for personnel from the Operator organisation. For Contractor personnel a statistically significant difference was noted between the two groups with leaders of 2 or more people having a higher average PCQ score than individual contributors. No statistical difference was noted for this analysis when repeated for Sub-contract personnel. Finally, a non-parametric Independent-Samples test was conducted based upon experience length within the UK Offshore Oil & Gas Industry. There was no statistically significant difference noted between the five experience groupings ranging from less than 1-year to greater than 10-years.

The relative consistency of PsyCap scores obtained from the Offshore Workforce Safety Study was concluded to be reflective of the lack of

psychological capital management across the value chain. The researcher had anticipated individuals with lesser industry experience to [perhaps] have a lower total PsyCap score than personnel with longer industry experience. Due to lack of PsyCap management it may be considered that once a certain level of PsyCap has been reached it becomes maintained through repeat work experiences rather than developed and increased through active management (Luthans and Youssef, 2004). It was concluded that since there was no statistically significant difference between total PsyCap scores between Operator, Contractor, and Sub-contractor groupings, none at the experience level, the potential loss of competitive advantage through lack of Human Capital Management exists across the value chain and within each organisational typology (Miles and Snow, 1978).

5.5 ORGANISATIONAL TYPOLOGY AND SAFETY LEADERSHIP SENSE MAKING

Operator personnel who, as a group identified 76% as a Defender-type organisation, stated that the organisation desired to put leaders onto offshore assets who were aligned with the organisations ethics and values and who provided strong safety focus. This was confirmed not to result directly from inclusion in strategy or a metric on the scorecard. Rather, a safety strategy enabler to deliver positive safety outcomes and performance. The Operator had established [globally] a programme of well-defined leadership competencies but safety, as a core organisational value, was stated to be intrinsic to leadership training rather than a stand-alone programme. The researcher concluded that aspects of authentic leadership attributes (transparency, internalised moral/ethical perspective, balanced processing, and self-awareness) were visible from the identified leadership competency elements, but that safety leadership was driven through the organisational value position on safety. The annual performance appraisal system was confirmed to be the only means of assessing leadership effectiveness. Beyond appraisal, the assessment of safety leadership effectiveness appeared to be reliant on the outcomes from accident and incident investigations, whether failure in safety leadership had been a direct or contributory cause.

HSE Auditors interviewed from both Operator and Contractor organisations confirmed that leadership was a regular audit topic both internally and externally, but primarily from a standards compliance perspective given that published safety management standards contain requirements relating to Leadership, for example Section 5.1. of ISO 45001:2008 (Leadership and commitment). Auditors for the Operator organisation confirmed that no investigation of Operator Leadership Competencies was included within Operator internal HSE audits. Both Auditor interviewees confirmed that the audits conducted did not result in the identification of safety leadership types deployed by the auditee organisation, for example authentic, charismatic, transactional, or transformational.

Personnel interviewed from Contractor organisations (74% Prospector-type) provided similar responses to those received from Operator interviewees. Safety as an organisational value was not a stand-alone training programme, rather safety was intrinsic to other leadership training activities. Improvement in lagging safety performance metrics was also identified to be a measure of safety leadership effectiveness. Associated with this, several interviewees confirmed that their employing organisations also evaluated safety leadership by measuring and monitoring leaders' engagement [and visibility] in safety related activities, for example conducting asset and work site visits, participation in safety audits, safety inspections and verifications. Effective engagement was said to be assessed through individual performance appraisal.

Due to the range of different organisations represented in the Sub-contractor grouping (58% Analyzer-type and 27% Reactor-type. Sub-contractors interviewed frequently commented that they were engaged based on their engineering and technical competencies, not their leadership skills.

Quantitative data analysis of the Authentic Leadership Questionnaire (ALQ) was analysed by a variety of non-parametric Independent-Samples Tests. There were two versions of the ALQ, firstly where individuals were asked to rate their supervisor, and secondly where leaders of 2 or more people were asked to rate their own perceived leadership skills. A variety of test comparisons were performed considering total ALQ score plus scores obtained

at the feature level, with a number of statistically significant differences being observed, each of which may be considered as potential improvement opportunities for leader and follower ALQ improvement across the value chain.

Most significantly and in terms of total ALQ scoring, a statistically significant difference was calculated between the two independent sample groups where leaders of 2 or more people perceived their leaders to possess more authentic leader traits than individual contributors perceived their own leaders to possess. In another analysis, stripping the leaders of 2 or more people out of the ALQ-rating data (to ensure they did not feature in both groups being analysed; a non-parametric data analysis rule) and conducting a comparison of rater versus self-rater there was again a statistically significant difference noted with self-rater holding a higher total ALQ score across all work groups, Operator, Contractor and Sub-contractor. The conclusion drawn was that leaders consider themselves to be more authentic in leadership attributes than their followers perceive them to be. With Neilsen et al. (2011) considering the four elements of authentic leadership (transparency, internalised moral perspective, balanced processing, and self-awareness) contribute to worker hazard perception and risk perception, the reality for the assets in the sample population and manifest through the Operator, Contractor and Sub-contractor working population is that the contribution to key hazard and risk perception may be unknowingly diminished. Increased potential for accidents in the offshore workplaces may remain undetected until too late. This scenario typifies why the use of ALQ measurements as a leading indicator of safety may prevent future lagging statistics. Also, Eid et al. (2012) considered that authentic leadership may be positively related to PsyCap due to followers who perceive their leaders to be more authentic will in addition, experience emotional and motivational states corresponding to the PsyCap features of self-efficacy, hope, resilience, and optimism. This considered effect will be limited if leaders are less authentic than they believe themselves to be and Human Capital Management is under-developed, possibly absent in the case of individuals from the Reactor organisational typology.

5.6 OFFSHORE ASSET SAFETY CLIMATE SENSEMAKING

The Safety Climate Tool (SCT) provided a rich data set for research analysis. Upon charting the eight SCT factors for all seven surveyed offshore assets, the radar plot displayed a picture of near parity. To gain an improved understanding of measured safety climate strength, the Health and Safety Laboratory (HSL) (developers of the SCT) performance groupings were utilised. The categories had been designated as Poor (<35%), Average (≥35% to <65%), Good (≥65% to <90%), and Excellent (≥90%). The range of total SCT scores across the asset group was 73.95% to 79.42% therefore all securely in the 'Good' range. Utilising a non-parametric Independent-Samples comparative test it was deduced that there was no statistically significant difference between the seven assets' SCT scores.

A range of more granular Independent-Sample comparative tests were conducted to examine and detect variation at the SCT feature level: SCT features per asset; SCT features per Operator, Contractor, and Sub-contractor; SCT features per leader of 2 or more people and individual contributor; and finally SCT features per UK Offshore Oil & Gas Industry experience. Although there were a number of instances where the Null Hypothesis of the same distribution across the independent groupings (at the .050 significance level) was rejected, for the SCT analytical tests run the Null Hypothesis was retained on 75% occasions. This was considered to support the initial finding that there was no deduced statistically significant difference in the SCT scores across the assets included in the research activity.

O'Connor et al. (2011) recognised the usefulness of safety climate questionnaires as an effective tool for measuring safety climate perception. Payne et al. (2009) considered safety climate assessments as being capable of highlighting where threats to safety lie in an organisation (not to be underestimated in a Major Accident Hazard environment) permitting the targeting of intervention resources. Mearns et al. (2001) consider safety climate to be an important element of organisational reliability. Zohar (2003 and 2010) concludes that 30 years of research has validated the use of safety climate as a robust leading indicator of safety performance. These references, if not testimonials, speak to the importance of safety climate measurements

hence their inclusion in the research conducted. The Operator organisation whose typical UK Offshore Oil & Gas Industry value chain was the subject of research may be *pleased* with the 'Good' safety climate measurement score achieved. However. 'Good' presents an opportunity for advancing to 'Excellent' given the Moral, Legal and Financial basis of Health and Safety Management (think Piper Alpha). The catalyst for improvement was considered to lie in the authentic leadership and psychological capital discoveries made during the research undertaken

Considering the quantitative and qualitative data obtained through research it was concluded that the 'Good' SCT scores obtained across the seven sampled assets was significantly due to the Operator organisations insistence on 100% compliance with their control of work arrangements plus the clearly communicated safety strategy message (a safety culture artefact) that '*No job is so urgent or important that we can't take time to do it safely'* combined with the clearly stated safety expectation of the need to be '*Always Professional, Always in Control, every work site, every task, every day'.* Intended to be authentic and inspirational, the messages are strangely transactional. Confirmed through semi-structured interview the messages at times were perceived to mean '*comply or there will be adverse consequences.'*

5.7 LEADERSHIP, PSYCHOLOGICAL CAPITAL, AND SAFETY CLIMATE CORRELATIONS

Zohar (2003 and 2010) concluded that 30 years of research has validated the use of safety climate as a robust leading indicator of safety performance. Factors that positively influence safety climate perception are likely to influence positive safety outcomes. To that end, non-parametric data correlation analysis was conducted for SCT and ALQ-Rater scores, determining for the sample population a positive medium correlation between the two constructs; a stronger ALQ will influence a stronger safety climate perception, with a positive safety climate leading to improvements in hazard recognition and improvements in risk perception (Pandit et al., 2019), potentially leading to accident and incident reduction plus increased organisational reliability (Mearns et al., 2001). From the research conducted

it may be reasonably concluded that improvements in ALQ scoring (development in transparency, moral perspective, balanced processing, and self-awareness) may in the future assist in raising the eight safety climate factors for the seven researched assets from the observed HSL 'Good' gradings to 'Excellent'.

Non-parametric analysis was also conducted on the SCT and PCQ scores. Like the SCT and ALQ correlation, a medium positive correlation was achieved for SCT and PCQ scores; a stronger PCQ will influence the generation of a stronger safety culture. Established from the research, it was evident that a lack of investment in Human Capital Management had a negative impact on PsyCap development (Lorenz et al., 2016). It may also therefore be reasonably concluded that resources applied to Human Capital Management, ergo PsyCap development will have a commensurate positive effect on safety climate perception.

A final correlation was calculated for PCQ and ALQ and deduced to be medium-positive also. However, although positive, the correlation coefficient calculated determined that the relation between the two constructs was not as strong as it was each individually with the SCT. What could not be determined from the research conducted was does PsyCap mediate the relationship between ALQ and SCT or is ALQ the mediator between PsyCap and SCT. Also, it could not be determined whether ALQ was an antecedent of PsyCap or *vice versa*. Both cases present a possible future research opportunity.

5.8 RESEARCH OBJECTIVES

The outcome of the research activities described in sections 5.1 to 5.5 were related to each of the established research objectives in turn. Saunders et al. (2009) considered that to deliver the necessary level of precision with research, the development of research objectives is required to stimulate a greater degree of rigorous thinking, derived through use of more formal language. The outcome of the research activities undertaken were related to each of the established research objectives in turn.

Objective 1: To determine the extent of the influence exerted by organisational typology on the construction of safety strategy as an aligned element of overall organisational strategy.

From semi-structured interview, only Defender and Prospector organisation typologies (deduced as Operator and Contractor organisations) gave indication of safety strategy being aligned with overall organisational strategy. Interviewees confirmed that some form of balanced scorecards were in play linking safety strategy to organisational strategy. The Operator highest-level scorecard included both leading and lagging safety performance data. Contractor interviewees confirmed that their highest-level scorecards relied on lagging safety performance data only. In both cases, safety strategy as expressed through policies, plans and procedures (Andrews, 1971; Hofer and Schen-del, 1978; and James, 1984) containing both leading and lagging safety performance measures were very regularly reviewed through daily, weekly, and monthly meetings.

For Sub-contractors, deduced Analyser and Reactor type organisations, the safety and organisational strategy picture was very diverse. SME organisation interviewees emphasised their employing organisations reliance on third party certification to safety management system standards, including setting and managing goals, targets, and objectives. Interviewee's from micro-businesses and self-employed persons confirmed an absence of safety strategy, engagement based on niche skills, plus total reliance on the Operator company management system requirements.

Boswell et al. (2006) reasoned that effective strategic safety management and decision making, when combined with line of sight (LOS) considerations, would be effective in connecting functional level Human Factors activity with business and corporate level goals and objectives. From the research data collected and anlaysed this consideration is, at best, being achieved within the Defender and Prospector organisation types identified. The first research objective was considered satisfied through data collected and finding results. Objective 2: To establish whether the psychological forces component of Human Factors is embraced within constructed safety strategies, considering psychological capital as an antecedent of safety focused behaviour.

Considering safety strategy to be expressed through policies, plans and procedures (Andrews, 1971; Hofer and Schen-del, 1978; and James, 1984), semis-structured interviews determined HF was only present in the safety strategy of Defender and Prospector organisational typologies (Operator and Contractor). It was confirmed that there was some HF inclusion within safety management system procedures for both groups within the value chain, for example within Operator Asset Safety cases, but it is typically very high level and aimed at positively influencing Hazard Identification only. Several of the interviewees stated that HF is acknowledged within their employing organisation's incident investigation procedure with regard to identifying human causes of accidents and incidents where HF analysis is intended to form an important part of the investigation process, recognising that human behaviour should be considered alongside technical causal factors during an investigation. None of the interviewees gave recognition that the dynamics of social interaction plus psychological forces as an element of HF possess a recognised ability to defeat safety barriers (Storseth et al., 2014).

Dul and Nuemann (2009) suggested that by connecting HF to organisational strategy, a positive motivation for the application of HF may be created. Such a perspective may promulgate improvements in overall business system performance as well as in safety performance. From the research conducted it was concluded that the knowledge of HF across the value chain was not mature. The lack of inclusion in safety strategy, linked to overall business strategy was likely to be a limiting factor with regard to both safety performance (Zohar, 2003 and 2010) and organisational competitiveness (Fernandez-Muniz et al., 2009; Marimuthu et al., 2009; Unger et al., 2011; Diaz-Fernandez et al., 2014; and Kottaridi et al., 2019;). Until HF becomes fully embraced within safety strategy aligned with organisational strategy, improving safety performance as measured by safety climate from 'Good' to 'Excellent' may not be operationally possible. The second research objective was considered satisfied through data collected and finding results.

Objective 3: To describe the organisational typology associations with specific styles of safety leadership at the operational level on offshore assets during the lifecycle phases.

From critical literature review, authentic leadership was selected to be a primary point of focus because, with regard to matters of safety, the leadership style directly affects safety outcomes through the promotion of positive safety climate perceptions (Nielsen et al., 2011; Eid et al., 2012). There were no typology associations noted with other specific styles of safety leadership at the offshore assets, such as transformational leadership (Barling et al., 2002; Mullen and Kelloway, 2009; and Conchie, et al., 2011). All assets clearly identified authentic leadership traits however there were no statistically significant difference calculated between the different typology work grouping identified for Operator, Contractor, or Sub-contractor. The measurement tool deployed under academic licence was the Authentic Leadership Questionnaire which specifically looked for authentic leadership traits (transparency, moral/ethical, balanced processing, and self-awareness). These traits were clearly identified as being present. The measurement tool was not designed to assess whether the leadership style presenting was purely authentic, or some other form of positive leadership style as mentioned above. Again, the research objective was considered satisfied through data collected and finding results.

Objective 4: Determine how the preceding three aspects of safety strategy implementation combine to produce individual asset safety climate profiles.

From the research data analysed there was no evidence produced to demonstrate that organisational typology for Operator, Contractor, or Sub-contractor organisations influenced individual asset safety climate profiles. Despite typology profiles being clearly identified across the Operator value chain (Operators and Contractors as Defender and Prospector plus Sub-contractors as Analyzer and Reactor type organisations) it was concluded that the strength of the Operator safety message was the over-arching influencing factor and not individual organisational typology.

Psychological capital was positively correlated to safety climate scores as was the perception of authentic leadership traits. However, that lack of statistically significance between [both types of] score whether by asset, workforce grouping or experience in the UK Offshore Oil & Gas Industry led to the conclusion that the mediating effect [power] of the Operator safety

message and safety expectations was consistently considered greater than the influence of psychological capital and authentic leadership on safety climate perceptions. The data produced appeared to give rise to a capping effect leaving safety climate consistently 'Good' across all seven assets. Good may not be good enough to prevent accidents occurring for 'old' reasons with new people (Hackitt, 2013) and therefore wholehearted reliance on the Operator safety message may impede organisations operating in the UK Oil & Gas Industry from implementing appropriate business strategies, supported by effective leadership. Psychological capital and authentic leadership were calculated to be positively correlated to each other (medium strength) although weaker than both individual constructs positively related to safety climate scores. It was not determined which of the constructs was the antecedent of the other, therefore identifying a possible area for future research. Based on the findings produced, the research objective was considered to have been satisfied through the data collected and findings determined.

Objective 5: Determine whether safety performance as reflected through safety climate perception is driven by individual organisational typologies or by the Operator company overarching safety message.

The mediating effect [power] of the Operator safety message and safety expectations was consistently considered greater than the influence of value chain organisational typology on psychological capital, authentic leadership, and safety climate perceptions within the offshore workforce across all seven of the Operator company's assets sampled. Although commendable, when operationalised and re-considered it may be possible that the strict imposition of compliance (with inferred negative consequences through breach as mentioned in some semi-structured interviews) may be an impediment to progressing safety performance levels from 'Good' to 'Excellent'. The working relationship between Operators, Contractors and Sub-contractors can be extremely complicated. Contractors and Sub-contractors frequently possess specialised skills that only they can safely and effectively manage; enforced compliance to the Operators safety message, and control of work systems may be inefficient and bureaucratically demanding with an inherent propensity to encourage violation through shortcuts. Blind compliance may

generate consistently 'Good' safety climate but may stifle innovation, efficiency, productivity and ultimately competitiveness (Fernandez-Muniz et al., 2009; Marimuthu et al., 2009; Unger et al., 2011; Diaz-Fernandez et al., 2014; and Kottaridi et al., 2019;). The final research objective was considered to have been satisfied through the data collected and findings output.

5.9 DATA AND FINDINGS CHALLENGES

Chapter 3, section 3.7 provided detail on limitations anticipated during design of the research methodology. Conducting both the qualitative and quantitative data collection identified some additional challenges that had not been anticipated during the methodology design stage. Firstly, during semi-structured interviews where participants had been selected through a non-probability purposive sampling procedure based on the judgement of the researcher (Saunders et al., 2009) a significant number of *no-show* and late call-off from interview was experienced. This necessitated additional managers and supervisors being brought in for interview to the Sub-contractor pool, where there were eventually more individuals interviewed from micro-businesses and self-employed personnel than had been identified in the original purposive sample by the researcher. Many of these individuals stated they were employed by the Operator company primarily based on personal and niche competencies; they were highly dependent on Operator management system requirements in the absence of any (other than statutory required governance) within their own employing organisations. The result led to a likely inflated identification with Reactor-type organisations (measured at 27%) and lowering of the Analyzer-type identification (measured at 58%). The researcher did not consider the challenge to have ultimately impacted the overall pattern of typology identification across the value chain given that no Sub-contractor personnel identified with Defender and Prospector organisation types. The second challenge encountered related to the conduct of the Offshore Workforce Safety Study conducted across sample assets A1 to A7. The data delivered, as per the researchers' expectations, was extremely rich as evidenced by the quantitative data analysis presented in chapter 4. However, research approval did not come with the ability to travel offshore to conduct any form of follow-up interview, for example structured, semi-structured, or focus group interviews (Saunders

et al., 2009; Bryman, 2012). The logistics and costs associated with [at least] seven offshore trips could not be supported [understandably] by the Operator organisation, not least because helicopter seats and asset bed space offshore are typically in high demand operationally. There was no other funding available to expense the offshore travel should flights and accommodation have been made available. Had offshore visits been possible, interviews conducted may have provided more granular data to inform why, for example: there was no statistical difference at the 0.50 significance level in psychological capital based on duration of Offshore UK Oil & Gas Industry experience; similarly, there was no statistically significant difference between psychological capital for the three workforce groupings of Operator, Contractor, and Sub-contractor; and why did Leaders of two or more people identify that they possessed greater authentic leadership characteristics in themselves than their followers perceived – a fact determined to be statistically significantly different at the 0.50 significance level. The researcher did not consider the lack of travel and interview permission to reduce the validity of the research undertaken, the deduced findings, and subsequent conclusion. However, with interview, the findings may have led to enhanced conclusions, possibly additional areas for future research, and some additional recommendations to stimulate improvement in safety performance at offshore assets.

5.10 CHAPTER SUMMARY

This chapter presented to the reader a discussion and evaluation of the research findings obtained from the adopted pragmatic research philosophy and the established triangulation methodology. The research findings were considered in context with the key literature review features and emergent content to deliver satisfaction of the research objectives. Finally, additional limitations experienced with data and findings were presented. The following chapter will present to the reader conclusions drawn from the research undertaken and identify the unique contribution of the research study to safety practice, safety science knowledge, and research methods. The final chapter will also make suggestions for possible future safety science research.

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CHAPTER 6
CONCLUSIONS, CONTRIBUTION, AND RECOMMENDATIONS

6.0 INTRODUCTION

By way of conclusion and following the discussion and sense making documented in chapter five, this chapter will inform the reader of the research conclusions drawn to demonstrate satisfaction of the research aim:

'*Explore the ways in which organisational typology, strategy, leadership, and psychological forces contribute to safety performance'*.

Additionally, the chapter will outline the unique contribution the research has made to professional practice, safety science knowledge, plus research methodology. The chapter will also proffer some recommendations for safety management practice and suggest areas for future safety science research.

6.1 RESEARCH CONCLUSIONS

Following generation of the original research idea and establishment of the aim, the research process commenced with the generation of six general focus research questions. These were subsequently utilised to provide the basis for research objective development, creating greater specificity in the research undertaken (Saunders et al., 2009; and Bryman, 2012) and to direct the literature review. By utilising a data triangulation approach, the Researcher took the opportunity to make an original and unique contribution to safety science by examining the research aim through different means (both quantitative and qualitative) as part of a mixed methods study. This has been demonstrably achieved through the data collected and analysed (chapter 4) with the findings subsequently discussed and evaluated (chapter 5). From research, four clear conclusions were drawn.

Firstly, utilising the Miles and Snow (1978) seminal model of organisational typology it was possible to determine the organisational typology makeup for a typical UK Offshore Oil & Gas Industry value chain, comprising Operator, Contractor and Sub-contractor organisations. This determination has not

been conducted previously. Knowing the characteristics (advantages and disadvantages) of the four typologies may provide opportunities for supply chain management across the value chain leading to safety improvement at offshore assets. For example, comprehensive understanding of organisational typologies making up an Operator company's value chain, the propensity for improving horizontal collaboration relationships (in this case around safety performance) is likely to increase. Determining meaningful understanding of the typology characteristics of companies that make up the value chain, the advantages, disadvantages, and likely behaviour patterns associated with each type (Defender, Prospector, Analyzer, and Reactor) provides greater likelihood of achieving improved safety strategy alignment; ultimately leading to improved safety performance on offshore assets.

Secondly, organisational typology does not influence safety performance on offshore assets as measured through safety climate perception scores. There was no statistically significant difference calculated between the three work groups of Operator, Contractor and Sub-contractor organisations comprising the four Miles and Snow (1978) typologies. Except for Operator company personnel, who are used to following the governance because it is *their* operating management system, the typology held by an individual's employing organisation becomes essentially irrelevant. Once offshore, the controlling influence becomes the Operating company's control of work arrangements that must be complied with.

The third conclusion considered both authentic leadership and psychological capital to be positively correlated with safety performance as measured by safety climate perception scores. However, their potential (individually and collectively) was not being maximised across the value chain. From semi-structured interview it was confirmed that neither construct was a clear feature of established safety strategy, nor was data collected in the form of leading indicators contributing to safety performance as an aligned element of organisational strategy. From qualitative data it was evident that both constructs were positively correlated to safety climate perceptions. However, in the absence of clear strategic drive, the researcher concluded that the potential for both constructs to generate further improvements in safety performance appeared restrained, with the progress from 'Good' to 'Excellent'

safety climate scores likely to occur at a slower pace than may actually be possible given the positive correlation between both constructs and safety climate strength.

Finally, the Operator safety message and safety expectations were identified as the mediating variable in the relationships between the independent (predictor) variables analysed (typology, authentic leadership, and psychological capital) and the dependent (criterion) variable safety performance as measured through safety climate perception scores. The safety message and expectations communicated are extremely compliance orientated and while sufficient to achieve consistently 'Good' safety climate scores across the seven assets studied, rationally mechanistic compliance may be a contributing impediment to achieving 'Excellent' safety climate scores in the future.

6.2 RESEARCH CONTRIBUTION

The UK Offshore Oil & Gas industry continues to present a highly hazardous working environment for personnel travelling offshore, irrespective of their intended activity: exploration, operations, asset life extension or decommissioning. There is genuine concern the potential remains for accidents to occur for 'old' reasons. At a conference event held to mark the 30th anniversary of the Piper Alpha disaster (Safety 30, 2018) Lord Cullen, who conducted the official disaster investigation, presented an address containing a stern reminder of the dangers of complacency, particularly the dangers associated with not recognising or effectively acting upon warning signals. Lord Cullen's Piper Alpha investigation and report are generally credited with raising safety standards within the UK Offshore Oil & Gas Industry. Oil & Gas UK's annually published Health & Safety Report (OGUK, 2018a) documents this overall improvement; section 3.1 of chapter 1 provides examples for fatal injuries offshore, over-seven-day specified injuries, and process hydrocarbon releases. However, in addition to demonstrating improvement in safety performance, the Oil & Gas UK Report (*ibid*) indicates there remains clear potential for further improvement. This was endorsed by the 2019 report (OGUK, 2019b) that reported: a 12% increase in reportable process safety incidents during 2018; four major

hydrocarbon release incidents; and an upward trend in safety critical maintenance backlog. Positively, there were no fatalities reported during 2018 but the over-seven-day injury rate increased by 12% during 2018 and the UKCS lost-time injury frequency (0.72 per million hours worked) is higher than the all-European average (0.7 per million hours worked).

Henry Ford is frequently quoted as having said "*If You Always Do What You've Always Done, You'll Always Get What You've Always Got*". The originality of the conducted research was to depart from the norm of investigating safety performance from an operational and technical perspective. Instead, the research examined safety performance through a strategic lens with consideration for the psychological forces dynamic within Human Factors, acknowledging that the dynamics of social interaction have the potential to defeat established safety barriers resulting in accidents (Storseth et al., 2014) with potentially catastrophic outcomes for UK Offshore Oil & Gas Industry operating assets. No application of the Miles and Snow (1978) organisational typology (Defenders, Prospectors, Analyzers, and Reactors) within strategic safety studies of the UK Offshore Oil & Gas Industry had been identified through literature search. Noting the typology approach to have been consistently and widely adopted in strategic research Desarbo et al., 2005; Lin et al., 2013; Helmig et al., 2014; and Hung et al., 2017) since its 1978 inception it was subsequently placed at the heart of the research methodology constructed.

A Doctor of Business Administration (DBA) is considered equivalent to a PhD but more applied in nature (RGU, 2018). The academic qualification is purposely structured in a manner to generate knowledge and understanding within a research field that will contribute to enhancing policies and practices in a modern management environment. From that perspective, and given the conclusions reached, the unique contribution of the research was identified at three levels: Safety Practice; Knowledge; and Methodology.

6.2.1 Contribution to Safety Practice

For UK Offshore Oil & Gas Industry stakeholders working across the value chain plus safety practitioners, the research conclusions provided a clear

illustration of the safety performance improvements to be realised by moving beyond the rationally mechanistic focus of compliance to policy, process, and procedure with a strong engineering and technical bias. Having a safety strategy that aligns with organisational strategy is seen from research as essential to drive safety performance and organisational competitiveness. Safety strategy would be further meaningfully enhanced if it included a psychological capital dynamic of HF plus authentic leadership constructs. Both can be objectively measured in a manner that provides leading safety performance indicators to strengthen the business balanced scorecard, in addition to the more traditional lagging performance indicators. In this way, Operator, Contractor, and Sub-contractor organisations would be organised to achieve, and demonstrate, a level of safety performance that is more than just the absence of accidents.

The Operator safety message and safety expectations deliver strengths to safety performance through compliance with control of work arrangements. However, it was evident from the research findings that this singular focus on compliance limits the potential benefits to be obtained through authentic leadership practices plus investment in psychological capital. The safety message and expectations communicated are sufficient to achieve consistently 'Good' safety climate scores across the seven assets studied. The stringent focus on compliance combined with the knowledge of penalty for non-compliance may result in a more transactional leader-follower type relationship where, on offshore assets, there is no clear incentive or reward for proactive and improvement-directed behaviour. Kahn (1990, 2010) considered improvement in work-place performance may be achieved when personnel consider themselves to be actively engaged, and subsequently more able to employ themselves without fear of negative consequences; individuals were considered more likely to engage themselves when they perceive there is a low risk of doing so. Following Kahn's determination, the researcher concluded that when offshore personnel (Operator, Contractor, and Sub-contractor) are highly compliance driven, they will be most likely to focus on compliance with control of work arrangements and be less likely to raise suggestions for improvement. As a result, the rationally mechanistic focus compliance acts as a continual impediment to the achievement of 'Excellent' safety climate scores in the future. The research highlights that

the disclosed mediating effect of Operator safety message and expectation requires to be better and further understood for its potential to be maximised, and the impediment effect on safety performance improvement to be minimised.

Awareness of organisational typology within the value chain has the potential to increase effectiveness of supply chain safety management, not least through improved horizontal collaboration relationships, a greater likelihood of improved safety strategy alignment, plus more enhanced audit, and assessment activity.

6.2.2 Contribution to Knowledge

The research incorporated an organisational typology approach to safety strategy and its influence on offshore asset safety performance, something which has not been done before in the context of safety science. Although typology was ultimately proven not to influence safety performance at offshore assets due to the mediating effect of the Operator safety message and expectations, the typology determination offers potential for improved supply chain safety management across the value chain.

The research demonstrated it was possible to bring together objective data (qualitative and quantitative) collected from two separate research populations across a single value chain for sense-making purposes. The two data populations although separate, one onshore and one offshore, had a common purpose to safely produce hydrocarbons in the form of oil and gas. The onshore population supported the offshore population activities, provided much of the safety performance governance along with the engineering, planning, and technical expertise input. The offshore population enacted the governance, engineering, and technical inputs in a highly complex and hazardous working environment. The research study constructed enabled sense to be made from the onshore perception of how safety performance was intended to be achieved and the offshore reality of how safety was achieved on a practical and daily basis.

Typically, on UK Offshore Oil & Gas Industry assets, a majority of personnel working are from Contractor or Sub-contractor organisations. This was reflected in the research undertaken where the significant percentage of respondents were Contractors and Subcontractors (65% and 14% respectively). These individuals were from organisations with different typologies and safety strategies from those held by Operator company. From these differing strategy choices and organisation types, deliberate choices will have been made by Contractor and Sub-contractor organisations regarding their technology, structure, and processes plus the necessary and integral human capital required for them to be competitive and organisationally successful. The safety strategy alignment and typology aspects of Contractor or Subcontractor companies are given zero consideration at the offshore asset level by the Operator company, where the focus is managing safety to deliver safe and efficient production of hydrocarbons. In blindly demanding compliance with safety governance and control of work arrangements it may be contended that the Operator company was attempting to manage safety culture at the asset level. As Martin (1985) noted, culture [hence safety culture] is complex in nature; it emerges from members rather than becoming created by leaders. The Operator company researched did not describe its organisational [safety] culture as simplistically compliance-based, it was intended to be the product of members internalising and observing clearly stated organisational values where safety was integral to all aspects of organisational activity. By being highly compliance driven a significant number of offshore personnel (79% in the research) will most likely be focused on staying within the Safety Triangle (compliance with control of work arrangements) and be less likely to raise suggestions for improvement or becoming immersed in the Operator safety culture. Compliance with governance and control arrangements through alignment may be sufficient to consistently achieve "Good" SCT scores. However, alignment through compliance will not deliver immersion in the desired safety culture nor the antecedents of improvement focused behaviours. Maintaining the process employed at the time of research was concluded unlikely to deliver "Excellent" safety climate scores in the future as a robust leading indicator of safety performance. This knowledge had not been identified from any previous safety science research included within the critical literature review.

Boal (2004) considered that strategy and leadership provides a vision and road map to permit organisations to evolve and innovate. The study confirmed Boal's considerations for leadership contribution, with authentic leadership being positively correlated to safety performance through measured safety climate scores ('Good') at each asset. Across the value chain, however, strategic alignment varied across the differing typologies; from semi-structured interview it was observed to be absent with the Reactor typology. Unknown before the research was conducted, it was concluded that typology and strategy associations for Contractor and Sub-contractor organisations did not influence safety performance as measured by safety climate scores, due to the mediating effect of the Operator's control of work governance compliance requirements. Boswell et al. (2006) concluded a consistent HF definition when aligned with strategy and effective leadership may lead to increased safety performance. The findings of this study demonstrated that safety performance measured through safety climate was 'Good' across all seven assets studied despite an observed lack of HF understanding maturity and a lack of strategic alignment across the Operator's value chain. The claim being made from the research is that a consistent HF definition when aligned with safety strategy [linked to organisational strategy], supported by authentic leadership and a psychologically capable workforce may propel an asset to 'Excellent' safety performance.

Not previously reported in safety science research, the study confirmed the Operator safety message as an important mediating variable, capable of limiting the influence of differing organisational typologies, plus reducing the benefits to be gained through authentic leadership and psychological capital influence. The study was conducted on a typical value chain, representative of the UK Offshore Oil & Gas Industry and it is *normal* for Operator companies to have a concise safety message supported by a series of safety expectations. Knowledge gained from the research demonstrates the importance of understanding the mediating power of these safety culture artefacts. In this way the positive benefits leading to improved safety performance may be maximised, the negative un-intended consequences minimised.

6.2.3 Contribution to Method

Given the more *practical* considerations of the DBA, the research confirmed the value of deploying (where possible) previously established and validated data collection tools within the techniques and procedures of the research being conducted. Doing so permitted a greater percentage of available research time to be allocated data analysis and sense-making of the findings rather than proving data collection method(s) validation. Using such an approach to method deployment also provides opportunity for novel application of data collection instruments in areas where they had not been previously used. Within the conducted research, the HSL Safety Climate Tool (SCT) was used for the first time in a data collection exercise along with the Authentic Leadership Questionnaire (ALQ) and Psychological Capital Questionnaire (PCQ) in a UK Offshore Oil & Gas Industry application. The method deployed was also a re-validation of the SCT application in the Oil & Gas Industry; its first use came in previous research (Spence, 2013) as a stand-alone instrument. Using SCT combined in an Offshore Workforce Safety Study delivered reliable data, confirmed through use of Cronbach's Alpha and Inter-Item Mean Correlation determinations.

A final, practical, method contribution came directly from the second additional limitation described in chapter 5, section 5.7. The contribution is an identified emphasis [perhaps necessity] to have research permission that includes data gathering interviews, for example structured or semi-structured, when conducting research on offshore installations. The research populations are *remote* on offshore assets and logistically constrained. It would be preferential to have interview permission granted and subsequently not used rather than attempting to obtain it later. Also, personnel change regularly on assets; in returning later to interview, a researcher may interview subjects that did not complete the original research questionnaires, a different population, thereby reducing the viability of data collected and outcome of research. This practical contribution is directed at researchers with little practical experience of the UK Offshore Oil & Gas Industry and the associated logistical challenges; flight and bed-space availability.

For the research conducted, interviews would have been explanatory in purpose, not least to further explore the mediating role of the Operator company safety message relationship between the independent (predictor) variables of typology, authentic leadership, and psychological capital and the dependent (criterion) variable of safety performance. The research approval was granted [and accepted] in the knowledge there was no provision for offshore interview to be conducted across the seven assets sampled. The lack of interview did not detract from obtained data validity and reliability however there was reduced ability to obtain insight into the 'why' behind the 'what' during data analysis and sense-making research activities.

6.3 RECOMMENDATIONS FOR PRACTICE

Given the DBA's focus on generating knowledge and understanding within a research field that will contribute to enhancing policies and practices in a modern management environment (RGU, 2018), chapter 1 section 10.0 highlighted anticipated research recommendations likely to be of interest to a wide range of stakeholders in the UK Offshore Oil & Gas Industry, including safety practitioners and managers. Intended to provide for improved safety performance, the recommendations were anticipated to address: improved safety strategy alignment with organisational strategy; development of safety leadership skills; enhanced psychological strength of the offshore workforce; and improvements to Contractor and Sub-contractor evaluation and control within the value chain. Following the research conducted, findings discussed, and conclusions drawn, four recommendations subsequently created with an intent to assist with development and implementation of appropriate business strategies, supported by effective leadership, to ensure that accidents no longer occur for 'old' [Piper Alpha-era] reasons.

Recommendation 1 addressed safety strategy. From the research findings it was confirmed that none of the Operator, Contractor or Sub-contractor organisations had safety strategy plans established as stand-alone documents. For Operator and Contractor organisations, safety strategies were present but documented across governance documentation supported by goals, objectives, and targets. Scorecards including safety performance measures were confirmed for Operator and Contractor organisations. For the

former, performance measures were confirmed to be leading and lagging in nature; for the latter, the performance indicators were lagging. It is recommended safety strategy safety becomes clearly aligned with organisational strategy to deliver not only continually improving safety performance improvement but increased competitiveness, innovation, and economic success while at the same time minimising the deterioration of human capital. Moreover, monitoring of safety performance through both leading and lagging indicators is critical to driving safety performance improvement and organisational competitiveness. The closed-loop management system model (Business Scorecard) linking strategy and operations provides a suitable model for achievement. Safety Climate perceptions have been validated as a robust leading indicator of safety performance. Given the research findings demonstrated both authentic leadership and psychological capital were positively correlated with safety performance the SCT, ALQ, and PCT measurement instruments are recommended to be used as leading safety performance indicators for input to a Balanced Scorecard aligning safety strategy with overall organisational strategy.

Recommendation 2 addresses development programmes to enhance the psychological capital (Efficacy, Hope, Resiliency, and Optimism) of the offshore workforce. The research identified a positive-medium correlation between the obtained PCQ scores and the perceived safety climate scores. Therefore, as the PCQ scores increase indicating strengthening psychological capital (PsyCap), the identified correlation indicates that the safety climate scores (as a robust leading indicator of safety performance) would also increase. This outcome identifies psychological capital as an antecedent of safety climate. Further, given there was no statistical difference determined between the three workforce groupings of Operator, Contractor and Sub-contractor the recommendation for PsyCap development is equally applicable to Operator, Contractor and Sub-contractor organisations. The anticipated outcome of such a development programme would be that offshore workers would be more psychologically capable, independently robust, and self-confident, such that they may be less susceptible to adverse dynamics of social interaction such as persuasion, pressure, and power. Also, more likely

to avoid pitfalls such as confirmation bias, normalisation of deviation, and groupthink.

Similarly, recommendations 3 concerns development programmes to enhance authentic leadership (transparency, moral/ethical, balanced processing, and self-awareness) practice and perception within offshore workforce. The research identified a positive-medium correlation between the obtained ALQ scores and the perceived safety climate scores. Therefore, as the ALQ scores increase indicating strengthening authentic leadership traits, the identified correlation indicates that the safety climate scores (as a robust leading indicator of safety performance) would also increase. This research outcome identifies authentic leadership as an antecedent of safety climate. Further, given there was no statistical difference determined between the three workforce groupings of Operator, Contractor and Sub-contractor the recommendation for authentic leadership development is equally applicable to Operator, Contractor and Sub-contractor organisations. Development of authentic leadership traits and improved understanding within the leader-follower relationship may eliminate the perception observed through the research where leaders consider themselves to be more authentic than their followers perceive them to be.

Finally, recommendation 4 encourages a step change in approach by moving beyond traditional rationally mechanistic and compliance based HSE audits and to include topics such as: safety strategy and strategic alignment; leadership competency and styles; plus, psychosocial risks. This proactive style of audit can be considered as leading in nature and offers up further potential for inclusion in a Balanced Scorecard approach, such as the closed loop management system with the opportunity to ensure alignment between safety and organisational strategy. By persisting with a rationally mechanistic and compliance-based approach to HSE auditing, both internally and across the supply chain, Operator and Contractor organisations are highly likely to be missing an opportunity to create safety performance improvements with the resultant shift in asset safety climate scores from ‘Good’ to ‘Excellent’. Such audits are not assisting organisations to validate and verify that they have developed and implemented appropriate business strategies, supported

by effective leadership to ensure they reduce the likelihood of having accidents and incidents for 'old' reasons.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Chapter 1 section 10.0 also highlighted anticipated research outcomes as new areas and topics for safety science research. Considering the data, findings, discussion, conclusion the following four areas for future research are outlined.

Firstly, and in the UK Offshore Oil & Gas Industry setting of offshore assets. authentic leadership and psychological capital, which is the antecedent? From the research conducted both constructs were seen to have a medium positive correlation to safety performance as measured by safety climate perceptions. However, there was a weaker, but still positive relationship between the two constructs. Research to determine which is the antecedent would have practical implications for human capital development leading to improved safety performance on offshore assets.

Secondly, and persisting with the positive psychology theme, an area identified for future research was to determine the antecedents and consequences of positive organisational behaviour on offshore assets, considering the role of psychological capital for promoting wellbeing among the offshore workforce during turbulent economic times in an industry with an increasingly less favourable public perception.

Thirdly, from the data collected and analysed, asset safety climate scores were consistently rated as 'Good' against the HSL established performance groupings. The Operator safety message and safety expectations were identified as the mediating variable in the relationships between the independent (predictor) variables analysed (authentic leadership, and psychological capital) and the dependent (criterion) safety performance as measured through safety climate perception scores. There may be value in researching the strength of the mediating variable to understand the degree of impediment to improving safety climate scores from 'Good' to 'Excellent'; possibly determining more effective means of harnessing the mediating power and leading to safety performance improvement.

Finally, a recommendation for conducting research to determine the psychosocial risks likely to be found on offshore oil and gas assets, to facilitate improved hazard analysis, risk assessment and risk control processes. Given that international safety management standards (e.g. ISO 45001:2018) do not deal explicitly with psychosocial risks, such research would also provide a robust basis for improved psychosocial risk auditing, including the identification of additional auditor competence and training requirements.

6.5 CHAPTER SUMMARY

The chapter concluded the thesis by presenting to the reader research conclusions to demonstrate how the findings deduced addressed the established research aim of:

'*Analyse the relationship between organisational typology, safety strategy (both its construct and implementation), leadership and safety climate'*.

In a study of this nature, previously not undertaken, the research identified organisational typology patterns across the value chain. Operator and Contractor organisations were determined to typically identify as Defenders and Prospectors; Sub-contractors as Analyzers and Reactors. Considering safety performance at the offshore assets as measured by safety climate perception it was concluded that organisational typology had no influence. psychological capital and authentic leadership were both found to positively correlate to safety climate scores, with each asset measuring as 'Good' on a validated scoring system. However, for all three constructs, the mediating effect of the Operator company safety message was strong through its insistence on compliance with the Operating company control of work arrangements.

Contributions to practice, knowledge and method were identified. Four recommendations were made for practice plus four for future safety science research.

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APPENDIX 1

Semi-structured Interview Schedule

<u>Interview Subject Background</u>:

Q1 Please describe your employing organisation and the services provided to the Operator Company.

Q2 What is your discipline background (e.g. engineering, science, business etc.)?

Q3 How long have you been in your current role?

Q4 What was your previous role?

Q5 How long have you been working in the UK Oil & Gas Industry

<u>Research Objective 1</u> (Organisational Typology):

Q6 For the value chain in question would your organisation be considered an 'Operator', 'Contractor' or 'Sub-contractor'?

Q7 In an attempt to determine the organisational typologies that make-up the Operator Value Chain. Can you highlight where your organisation fits into the various descriptions put in front of you? If there is no exact fit, it is OK to identify a *between* position.

<u>Research Objective 2</u> (Safety Strategy):

Q8 Does your organisation have a defined Safety Strategy?

Q9 Is it documented?

Q10 How is it communicated?

Q11 Is it an integral element of overall business strategy, part of e.g. the business scorecard?

Q12 If part of the business scorecard, what safety measures are included (e.g. leading or lagging indicators)?

Q13 Does the Safety Strategy include Human Factors aspects? If "yes" what aspects?

Q14 Does the Safety Strategy feature elements to (1) positively influence Hazard Identification (2) prevent the normalisation of warnings (3) avoid consensus mode decision making (4) avoid confirmation bias and (5) avoid group think?

<u>Research Objective 2</u> (Workforce Psychological Capital):

Q15 In an attempt to ensure your offshore workforce does not succumb to production versus safety pressures, what activities does your organisation engage in to support and encourage both workers and leaders to avoid this pitfall?

Q16 Do these efforts extend to staff and sub-contractor staff?

Q17 How would you describe your offshore workforce?

Q18 Are these steps taken as a direct result of the established Safety Strategy and included on the Scorecard?

Q19 Does your organisation engage in any assessment of the Psychological Capital levels within the offshore workforce?

Q20 If there is no measurement, how does the organisation know if it is being effective and achieving its aims?

<u>Research Objective 3</u> (Safety Leadership):

Q21 Please describe the type of safety leaders your organisation aims to put into the offshore workforce?

Q22 Are these steps taken as a direct result of the established Safety Strategy and included on the Scorecard?

Q23 Does your organisation conduct any type of safety leadership assessment and/or measurement?

Q24 If there is no measurement, how does the organisation know if it is being effective and achieving its safety leadership aims and objectives?

<u>Research Objectives 4 & 5</u> (Safety Climate):

Q25 Does you organisation conduct any safety culture or climate surveys as a predictor of safe performance within your offshore workforce?

Q26 If "*yes*", is this as a direct result of the established Safety Strategy and included on the Scorecard?

Q27 If "*yes*", what validated Safety Culture or Climate measurement tool is used?

Q28 How are the results of Safety Culture or Climate surveys used to improve safety performance in your organisation?

Q29 If you are not the Operator and do conduct Safety Culture or Climate surveys, how are the results feedback to the Operator organisation for their subsequent use?

Q30 In the event your organisation is a contractor or sub-contractor to the Operating organisation then your workforce will be subject to Operator company Control of Work arrangements. How is that considered to affect/impact your workforce safety culture or climate?

APPENDIX 2

Research Information Sheet

UK OIL & GAS INDUSTRY - OFFSHORE WORKFORCE SAFETY RESEARCH

Objective. This semi-structured interview has been designed in support of a 6-year part-time Doctoral research study that is evaluating the influence of organisational typology on safety strategy construction to address the psychological forces dynamic of Human Factors (HF) within: Operations, Asset Life Extension and Decommissioning.

The aim of the research is to "*Analyse the relationship between organisational typology, safety strategy (both its construct and implementation), leadership and individual safety performance capability*." The established research objectives are:

1. To determine the extent of the influence exerted by organisational typology on the construction of safety strategy as an aligned element of overall organisational strategy.
2. To establish whether the psychological forces component of Human Factors is embraced within constructed safety strategies, considering psychological capital as an antecedent of safety focused behaviour.
3. To evaluate the organisational typology associations with Authentic Leadership at the operational level on offshore assets during the lifecycle phases.
4. To determine how the preceding three aspects of safety strategy implementation combine to produce individual asset safety climate profiles across the value chain.

The information obtained from your valuable interview will be analysed alongside data obtained from document and literature review, also from a four-part offshore workforce survey.

Confidentiality. No asset, individual or organisation will be uniquely identified within the analysis or the subsequent thesis write-up. Raw data will be maintained confidentially by the Researcher and will subsequently not be shared with any additional party (individual or organisation). Data analysis will be completed exclusively by the Researcher:

Phil Spence, UK Decommissioning HSE Manager
[RGU Student ID 1011969 - p.a.spence@rgu.ac.uk]

Thank you very much for your cooperation with this ***original*** research project.

I willingly agree to participate in the research interview. I give my consent for the data obtained to be used in the research project outlined above.

Name:

Signature: **Date:**

APPENDIX 3

Organisational Typology Marking Grid

I consider my employing organisation to be characterised by:

Product/Market Sector	Narrow and specialised area of operation		Continually searching for new opportunities ;		Operate typically in one stable and once changing domain		Frequently perceive change and uncertainty in their area of operations
Senior Managers	Highly expert in the focused area of operations		Innovators who are capable of monitoring a wide range of environmental conditions, product/market trends and events.		For stable product/market sectors emphasise formalised structures and processes to achieve efficiency		No clearly articulated organisational strategy. Unable to respond particularly effectively to change in product/market sector
New Opportunities	Seldom search outside the existing sphere of operations		Can be creators of change and uncertainty so competitors must respond to their lead		Watch competitor closely for new ideas and adopt those that appear very promising		Reactive rather than proactive to product/market environmental pressures
Major adjustments to structure, technology or operating methods	Engaged in continual improvement but seldom required to make major adjustments		Driven by responses to emerging product/market trends. Regular experimental responses to emerging trends		Typically associated with adopted new ideas		Adjustments tend to be driven by product/market sector pressures
Improving efficiency of existing operations	Area of primary focus is to ensure maximum efficiency of existing operations		Not completely efficient because of focus on product and market innovation		Area of primary focus is to ensure maximum efficiency for stable operations		Lack of strategic alignment impedes efficiency improvement

APPENDIX 4

Offshore Workforce Safety Study Questionnaire (Abbreviated)

UK OIL & GAS INDUSTRY - OFFSHORE WORKFORCE SAFETY STUDY

Objectives

This survey document has been prepared in support of a 6-year part-time doctoral research study that is evaluating the influence of organisational typology on safety strategy construction to address the psychological forces dynamic of Human Factors (HF) within: Operations, Asset Life Extension and Decommissioning. The information obtained from this questionnaire will be analysed alongside data obtained from document and literature review, also from interviews conducted through a purposive sampling exercise.

The aim of this questionnaire is to obtain ***your*** valuable views on various aspects of work and/or the work environment related to safety climate and safety performance. To ensure that your own thoughts and opinions are objectively represented, please take the time to complete the document frankly and spontaneously. The questionnaire will take approximately 15 to 20 minutes to complete.

Confidentiality

The questionnaire is designed to be completed anonymously and the feedback will be treated confidentially. No individual or asset will be uniquely identified within the written results or the subsequent thesis write-up. Please complete the survey in the time permitted during the Safety Meeting then give it back to your HSE Advisor. Data analysis will be completed by the Researcher:

Phil Spence, UK Decommissioning HSE Manager
[RGU Student ID 1011969 - p.a.spence@rgu.ac.uk]

The questionnaire will be available from October 2018 until end-March 20199. Feedback on the research results will be provided to each surveyed asset during Q4 2019 once the analysis has been completed, evaluated and conclusions drawn. Thank you very much for your cooperation with this *original* research project.

How to complete the questionnaire

After indicating the name of the asset where you're working plus some anonymous outline points about yourself and your employing company, the questionnaire itself contains four sections. Depending on your role you'll be prompted to answer three **or** all four sections:

1) ***Leadership Part A*** *– to be completed by everyone.*
2) ***Leadership Part B*** *– to be completed if you lead teams of 2 or more people*
3) ***Safety Climate*** *– to be completed by everyone*
4) ***Psychological Capital*** *– to be completed by everyone*

Each of the four sections has a unique set of simple instructions for you to follow as an aid to successful completion.

Asset

What is the name of the asset (fixed platform, accommodation work vessel or drilling rig) that you are working on?

Asset Name:
…… [*to be anonymised in reporting*]

Points About Yourself

The following information will be used to make group comparisons only and your questionnaire will not be analysed on an individual basis. Please circle ***one*** response to each question.

A. Which phase of offshore activity are you involved in?

1. Drilling Well Operations
2. Production Operations
3. Asset Life Extension
4. Decommissioning
5. Plug & Abandon Well Operations

B. Are you a staff member with the Operating Company?

1. Yes
2. No

C. If "No" to Question B above, what is your employing company's relationship with the Operating Company?

1. Contractor (i.e. contracts directly to the Operating Company)
2. Sub-contractor (i.e. sub-contracts to a Contractor company)

D. On this asset, how do you fit into the organisation structure?

1. Individual contributor
2. Leader of 2 or more people

E. What is the length of your UKCS Offshore Oil & Gas Industry experience?

1. Less than 1 year
2. 1 to 3 years
3. 3 to 5 years
4. 5 to 10 years
5. Greater than 10 years

Section 1 - Leadership Part A
(*to be completed by everyone*)

*The following survey items refer to **your leader's style**, as you perceive it. Judge how frequently each statement fits his or her leadership style using the following scale and by putting an **X** in the corresponding box:*

Not at all	Once in a while	Sometimes	Fairly often	Frequently, if not always
0	1	2	3	4

Section 2 - Leadership Part B
(*to be completed only if you lead teams of 2 or more people*)

*The following survey items refer to **your personal leadership style**, as you perceive it. Judge how frequently each statement fits his or her leadership style using the following scale and by putting an **X** in the corresponding box.*

Not at all	Once in a while	Sometimes	Fairly often	Frequently, if not always
0	1	2	3	4

Section 3 – Safety Climate
(*to be completed by everyone*)

*Answer the following statements by placing an **x** in the box for the statement that most closely matches your opinion. For example:*

No.	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	January is a much colder month than June.				x	

Section 4 – Psychological Capital
(*to be completed by everyone*)

*Below are statements that describe how you may think about **yourself right now**. Use the following scale to indicate your level of agreement or disagreement with each statement and by putting an **X** in the corresponding box.*

Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree
1	2	3	4	5	6

Ease of Completion

Please advise your thoughts on the ease/difficulty of completing this questionnaire by putting an **X** in the corresponding box:

Easy	Quite easy	Neutral	Quite difficult	Difficult

Finally, do you have any additional comments about leadership, safety climate and/or safety performance on your asset? Please use the Additional Comments box on the following page.

THANK YOU VERY MUCH FOR YOUR ASSISTANCE

Additional Comments

APPENDIX 5

Offshore Workforce Safety Study – Comments

A2-34: "Feel most safe on *Asset A2* compared to other operated assets".

A2-43: "New safety initiatives often introduce new layers of paperwork, duplicating what we are already doing, but using vague and imprecise language. Formal permits and risk assessments are robust and well evolved to control work activities safely".

A5-25: "I don't think most of these questions were anything to do with safety".

A5-44: "It's easier for companies to go after easy things that the HSE legislation or provided guidance on. Anything that HSE doesn't really touch, Companies see their responsibility to act as minimal + something they don't have to worry about too much".

A5-68: "Another box ticking exercise".

A6-06: "You might not agree with all the rules all the time or the referee's decision every time but without them there would be no game at all. Just chaos".

A6-10: "Research Factor 4. Q27 – there are not too many procedures but to follow them there is often too much paperwork/checklists etc. which are repeated daily often for the same thing – this could be streamlined".

A7-10: "Management away from the decks/floor tend to jump on all small infringements but forget all those rules where it effects performance or down time. Double standards breed contempt for the rules. Either follow 100% or not!"

A7-24: "*Asset A7* team followed all standards. Good team work to set goals".

APPENDIX 6
Reflective Statement

At the time of finalising thesis write-up, I am employed as a HSEQ Manager, Decommissioning & Major Projects for a major Exploration & Production (E&P) company working in the UK Offshore Oil & Gas Industry. Previously in my 30-plus year career I have been a HSEQ Practitioner, a Management Systems Auditor, a Freelance HSEQ Consultant, and a Trainer.

I would strongly contend that my Doctoral journey began on 17th March 2009 when an employee of a UK Offshore Oil & Gas Industry service company I was working for at the time, someone I did not know and had never met, had an accident in a works vehicle after an alleged substance abuse episode. Several weeks later I found myself in an involuntary job separation situation, no recourse to unfair dismissal procedures, an uncertain future, and the potential for a significantly lowered prestige level (Malo and Munoz-Bullon, 2008). I was not '*fired*', rather I departed with a Compromise Agreement along with an overwhelming sense of professional indignation. As the seven-month incumbent HSE Manager I had paid the ultimate professional price, seemingly a '*scapegoat*' for the serious accident and subsequent organisational fall-out. Someone had to be at fault and there was no energy apparent within the company for establishing contributing factors; whether they were personal in nature, related to the workplace or indeed the company itself. The company wanted to set a HSE example and what better a way to do it than change out the HSE Manager. I had been asked to demonstrate my qualifications for the job and after re-presenting my Under-Graduate degree, HSEQ IRCA Auditor accreditations and Charterships (Institute of Biology and Chartered Quality Institute) I was informed they were no longer sufficient. As a direct consequence, I created a 5-year strategy of continuing personal and professional development to ensure the risk of [again] being the '*scapegoat*' was reduced to As Low As Reasonably Practicable (ALARP).

A key component of this strategy was to pursue accredited and formal education in the Occupational Health and Safety subject matter area. I enrolled with the Robert Gordon University, Aberdeen during academic year 2010/2011 to study for a Post Graduate Certificate in Health, Safety and Risk

Management. This was immediately followed by the Post Graduate Diploma; finally, successful completion of the Master of Science one year later. Participation in these Post Graduate studies added strength and substance to my '*day job*' and, I firmly believe, increased value to my labour and delivery. The studies also served to fuel my interest in areas such as safety climate, culture, leadership. They propelled me to new subject matter areas that I had never considered before such as strategy, positive psychology, plus human and social capital. At the end of the MSc study, I was left with a key unanswered question, where do further opportunities exist for improved health and safety performance in the UK Offshore Oil and Gas Industry? My application to enrol in the DBA program was subsequently submitted and my strategy for personal and professional development extended out to a 10-year plan.

Throughout my career, Continuing Professional Development (CPD) has consistently been a fundamental and intrinsically rewarding element of my working life. Naturally, I placed the DBA journey at the heart of CPD and management of my career path in Health and Safety (Hale and Booth, 2019) having made the deliberate choice of pursuing academic rigour over the National Examination Board in Occupational Safety & Health (NEBOSH) courses. Part way through the DBA journey I attained Graduate membership of the Institution of Occupational Safety and Health (Grad IOSH); upon completion of my DBA I shall dedicate time to seek full Chartered Membership (CMIOSH) and at a future career stage, Chartered Fellow (CFIOSH).

The collapse in crude oil prices during 2015 and subsequent persistent low-price environment has transformed the UK Offshore Oil & Gas Industry into a turbulent and volatile employment market. My employing organisation throughout this period had almost annual rounds of redundancy, with the number of job losses each year amongst staff necessitating statutory consultation under Employment Law. The level of workforce cuts also affected the supply chain organisations and there were also significant reductions in Contractor and Sub-contractor personnel. Anxiety levels (including personal) were understandably high during this period which made research and study extremely difficult. However, I remain convinced that the personal and professional development received through participation in the DBA process

enabled me to demonstrate additional added value for the organisation, thereby increasing job security. Since commencing my Post-Graduate journey, particularly the DBA component, my organisational and managerial responsibilities have increased significantly.

DBA studies have ensured that I approach my role through a strategic lens and I no longer occupy an HSE 'bubble'. I see HSE activities as means to an end rather than as an end in themselves. Gaining insight to the subject of Psychological Capital and its core construct of Efficacy/Confidence, Hope, Resiliency and Optimism has made a significant difference to my personal and professional life. I will continue to use the measurement tool as a personal barometer and a basis for future development. In a similar vein, the Authentic Leadership construct (transparency, moral/ethical perspective, balanced processing, and self-awareness) has become invaluable to me and my managerial responsibilities as an HSEQ Professional.

Possibly most importantly, the DBA process has resulted in my becoming more analytical and questioning than ever before during a 30-plus year career in Health and Safety, Environmental and Quality management. The research process exposed me to the stark realisation that, as a HSEQ Management Systems Auditor, I had been blinded by the rationally mechanistic nature of management system standards and therefore at best my deliverables provided for mediocrity rather than excellence in performance improvement outcomes. Such is the nature of the attitudinal adjustment that has occurred during my DBA journey, the analytical and questioning changes exist at a personal level too.

Where the future is concerned, there are ways in which I intend to capitalise and take forward on the education and learning commenced during my DBA journey. Certainly, I will continue with exploratory reading to further advance my knowledge and understanding in factors contributing to safety performance: particular emphasis on safety critical organisational applications. Secondly, I fully intend to use the knowledge gained [and future knowledge yet to be obtained] to work with my employing organisation to assist in delivering safety performance improvements recognising the psychological forces dynamics of HF plus effective safety leadership rather

than just the persistent focus on engineering and technical aspects of safety. Having identified potential research opportunities, I would like to maintain a link with Robert Gordon University and participate in research activity, possibly to extend the findings of the safety science research outlined in this thesis.

Thanks to Robert Gordon University for having faith in my potential, and for endorsing the original research proposal.

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