University of Southern Queensland

HOW ANTECEDENTS AFFECT OIL AND GAS WORKERS' PERCEPTION OF SAFETY AND THEIR INFLUENCE ON SAFE WORK PERFORMANCE IN SOUTHEAST ASIA.

A Thesis submitted by

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ABSTRACT

Significant variances in safety related behaviours exist between co-workers in onshore oil and gas drilling operations within the Southeast Asian Region. The resultant outcome of the differing behaviours is a high rate of personal injury to those employed within this field when compared to the entire workforce population.

Underlying individual antecedents facilitating the preparedness to undertake high risk workplace behaviours is an area that remains relatively unexplored, particularly within the onshore environment. This study seeks to examine individual antecedents and establish their prevalence in influencing both the perception of safety and safe work performance.

In order to understand this phenomenon relating to human behaviour, a pragmatic constructivist paradigm was adopted relying on sequential exploratory mixed methods design approach to generate the necessary data. Both qualitative and quantitative data were obtained and analysed providing the opportunity for this research to present integrated findings. Mixed methods approach was selected as the preferred research method for investigating the experience of a population to assist with the comprehension of their situational realities within a professional environment.

Areas of investigation led to the identification of antecedent factors that affect the perception of safety. Evidence reveals that respondents raised in rural areas indicated higher levels of risk tolerance based on the type of activities they engaged in in their formative years. Proximity to injury was also an important factor associated with the development of hazard awareness, evidenced by changes in the workplace after exposure to workplace incidents. Data confirmed that parental involvement in formative years assisted with the development of the fundamental understanding of safety that was carried into their early work experiences.

These findings generated knowledge that did not currently exist for onshore oil and gas workers within the region. Findings from this research have implications for organisations to better understand the inherent qualities of individuals, information that provides opportunities for the development of targeted interventions based on a constructed risk profile of their workforce.

CERTIFICATION OF THESIS

I Mark William Stacey declare that the Doctor of Professional Studies Thesis entitled How Antecedents Affect Oil and Gas Worker's Perception of Safety and their Influence on Safe Work Performance in South East Asia is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. The thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Date: 22 July 2022

Endorsed by:

Dr Dev Raj Paudyal
Principal Supervisor

Associate Professor Peter Gibbings
Associate Supervisor

Student and supervisor's signatures of endorsement are held at the University

DEDICATION

To my family who have remained patient with me throughout this journey I thank you for your encouragement and support. To my dearest family members who passed away while this research was being undertaken, I lament your loss and miss you every day.

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I would like to express my sincere gratitude to my Supervisory team for their ongoing commitment to both myself and this research. Without these extraordinary people, their endless support, guidance, and patience, completion of this research would have been unlikely. I would like to thank Dr Catherine Arden for guiding me towards the DPRS program and Dr Luke van der Laan for providing his expertise throughout the tentative phases of my candidature. Without your genuine interest and ongoing assistance, I am doubtful this research would have ever commenced let alone be complete.

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PUBLICATIONS ARISING FROM THIS THESIS

Stacey, M, Paudyal, D & Gibbings, P 2021, 'Application of mixed methods research in the onshore oil and gas drilling environment', *Mixed Methods International Research Association (MMRIA) – Oceania Chapter 2021 Regional Conference and Workshops: Looking for the Future, Sydney, Australia,* 9 Dec 2021. Awarded MMIRA-Oceania Regional Conference Best Paper Stream B: Using mixed methods for intervention and evaluation.

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CHAPTER 1: INTRODUCTION AND OVERVIEW

1.1. MOTIVATION FOR THE STUDY

This research was conceived because of the ongoing involvement of the researcher working on an operational oil and gas drilling rig in Southeast Asia. As a Safety Professional experiences in the oil and gas industry have required extensive investment of organisational resources into the conduct of investigations into workplace incidents resulting in potential or actual injury to personnel, environmental damage, or damage to operational equipment.

Operational obligations relating to monitoring safety in the workplace is fulfilled through daily workplace surveillance and reporting. These activities assist onsite management to identify and risk assess non-routine occurrences that are described as unwanted events. In the context of oil and gas drilling, unwanted events may take the form of procedural breaches, unacceptable human behaviours, operational variations, deviations from standard operation or any form of event that was unplanned and has the potential to cause unforeseen consequences as a result of its emergence Rout and Sikdar (2017). Due to a high number of unwanted events that required investigation, the researcher became curious about the repeated pattern of elements that frequently arose as playing a significant role in the cause of workplace incidents and provided the stimulus for undertaking this research. This study serves to explore and better understand the inherent qualities of individuals that contribute to the cause of incidents. While this research focusses on a particular industry and region, the issues under investigation exist more widely throughout the onshore oil and gas industry.

Anecdotal evidence as verified by four independent Safety Professionals with a collective experience of over 55 years of oil and gas industry experience indicates that junior workers without sufficient knowledge to perform tasks safely have the highest level of exposure to activities that may present harm. Figure 1 outlines the experience / exposure chart for positions associated with onshore oil and gas drilling crews. As crews progress throughout their career, the level of hands on work declines based on the work becoming more specialised and eventually almost completely administrative reducing their exposure to direct sources of harm.

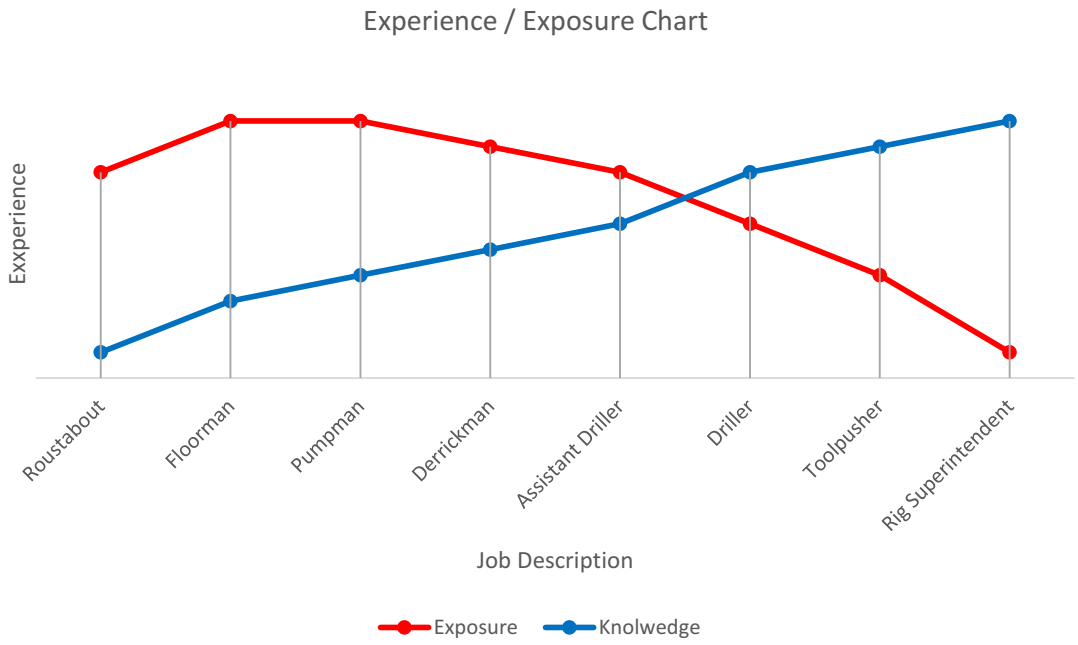

Figure 1: Experience / Exposure chart of oil and gas drilling crew

Compared to the offshore oil and gas drilling industry, onshore activities are frequently less studied, a factor contributing to the limited knowledge in this field and one that assisted with the identification and proposal of the research question. This chapter introduces the research problem, scope of the research and the setting in which the research was conducted. It also presents the aim of the research and questions formulated to assist the investigation. Finally, this chapter identifies the methodology selected for the conduct of the study as well as articulating and acknowledging some of the proposed research limitations.

1.2. BACKGROUND TO THE RESEARCH PROBLEM

Extractive industries are recognised as high-risk industrial environments. Within Queensland for example, pursuant to the operation of section 115(4) of the *Worker's Compensation and Rehabilitation Regulation 2014*, the oil and gas extraction industry is legislatively classified as a high-risk industry. According to the Australian New Zealand Standard Industrial Classification (ANZSIC) catalogue, published by the Australian Bureau of Statistics (ABS), exploratory and extractive activities for hydrocarbons including coal seam gas, crude oil or natural gas are high risk activities (Australian Bureau of Statistics 2013). The

onshore oil and gas drilling workforce subject to this study complete activities that comply with the ANZSIC categorisation and therefore conduct high risk activities in a high-risk industry.

Understanding the prevalence of incidents in the oil and gas industry is essential to frame and contextualise this research. Localised incident statistics are produced by the International Association of Drilling Contractors (IADC) who release quarterly reports based on information provided by operators in each region. Conveniently, the IADC provide separate statistics for both onshore and offshore drilling activities separated by region. This data contains numerous metrics that are useful to companies in benchmarking themselves against industry performance. Traditionally, companies tend to benchmark their occupational health and safety performance against the lagging indicator of Lost Time Incident Frequency Rate (LTIFR). Solomon (2015) proposes that LTIFR does not provide an accurate account of safety performance but rather gives an indication of how many events were reported, leading to a positively distorted image of workplace safety.

A distinction between the effectiveness of relying on LTIFR and Total Recordable Injury Frequency Rate (TRIFR) can be made as they are representative of specific reported events. The focus of this research is primarily concerned with human experience such as thoughts, beliefs and behaviours and their influence on safe work performance. Concern with the impact of all events, not just those resulting in lost time represents a paradigmatic shift away from the pure economics of injury towards the total adverse effect on individuals. O'Neil (2014), supported by Kabir et al. (2018) identifies LTIFR primarily as an economic indicator providing a measure of a worker's time away from their employment which is subsequently utilised to calculate the consequential financial loss to the employer. Accordingly, LTIFR it is not concerned with the nature of the illness or injury or their impact on the individual, rather, it is simply a measure of lost productivity as the by-product of an event without regard to the human experience (Solomon 2015).

Utilising the metric of TRIFR lessens the purely economic by-product of incidents by placing emphasis on all incidents that result in some harm to the employee humanising the harm caused to people by companies (Fricke & Ryan 2019). TRIFR requires organisations to

record reportable injuries and illnesses that have required more than the application of first and therefore reflect harmful events regardless of whether they resulted in time away from the workplace (O'Neil 2014; Fricke & Ryan 2019). Like the LTIFR, the TRIFR is a prepared at the end of a reporting period and is considered to be a lagging indicator reflective of historic occurrences. However, unlike the LTIFR, it measures all instances of harm suffered by a person acknowledging that these events have had an adverse effect on the wellbeing of a person and some of these events may lead to an organisation experiencing a loss of productivity. On this basis the TRIFR statistics have been relied upon to conduct an examination of safety performance within the onshore oil and gas industry for the Southeast Asia region.

Understanding the necessity for this research requires evaluation of the safety performance statistics for the industry in recent years. Safety performance is representative of how many people are being injured with performance expressed per million hours worked. The following section deals with the years 2018 to 2021 and relies on the data published by the International Association of Drilling Contractors (IADC) through their rig statistics reports for these periods.

In 2018 the onshore Australasian land drilling activities generated a TRIFR of 6.56 for the year 2018 (International Association of Drilling Contractors 2018b). Put simply, this means that for every million hours worked, 6.56 workers experienced an injury in the workplace that required more than first aid treatment. Further, in 2019 the TRIFR was reported as 3.25 (International Association of Drilling Contractors 2019) while 2020 saw a slight decline with a TRIFR of 3.20 (International Association of Drilling Contractors 2020). 2021 saw a dramatic decline in TRIFR where 1.08 workers were injured for every million hours worked (International Association of Drilling Contractors 2021). It is important to note that throughout this period the number of actual hours worked declined from 3,809,566 in 2018, to less than one million in 2021 (921,785 hours) representing a 75.80 percent reduction in hours worked. The reduction in worked hours during this period signifies a stabilisation of supply and gradual decline in global consumption from 2009 attributable to the emergence of renewable energy sources (Biscardini et al. 2018). The extreme reduction in hours during 2021 is indicative of the rapid cessation of drilling operations due to the onset of the COVID-

19 pandemic during the 2020-2021 period (Geoscience Australia 2021; Ogge & Campbell 2021). It is important to note that the 2021 incident frequency rate represents 33.75 percent of the total incident rate for 2020 despite the reduction in hours worked of 75.80 percent.

Data sourced from the Australian Bureau of Statistics (ABS) confirms that the labour force of the oil and gas industry contracted 23 percent between 2019 and 2020 (Australian Bureau of Statistics 2022a). Within a few months of the identification of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan China a global pandemic known as COVID-19 emerged (Parveen 2021; Guzman et al. 2022). The advent of the COVID-19 pandemic has resulted in decreases in expenditure within the oil and gas industry. According to Chopra (2020) the long-term impact of reduced expenditure will likely result in a skills shortage primarily attributable to the immediate cuts to capital and operational expenditures during the initial phases of the pandemic in 2020.

Although useful to gauge overall HSE performance, reporting of lagging indicator statistics does not assist with the identification of causal factors which may assist in the reduction or elimination of incidents within onshore oil and gas drilling operations. At the time of writing the oil and gas extractive industry represented 0.18 percent (36,000 workers) of the Australian working population of 13.4 million people (Australian Bureau of Statistics 2022a; McConville 2022). Reduction in TRIFR within the industry between 2020 and 2021 from 3.2 to 1.08 while encouraging, must be viewed in context of the 75.80 percent reduction in hours worked. In the absence of research into the reasons for the reduction in recordable incidents attribution to any factors would be speculative (Oswald et al. 2018).

Lagging indicators are the result of a culmination of factors that have contributed to an undesired outcome and do not necessarily provide an accurate reflection of safety within the workplace (Jablonowski 2012; Solomon 2015). Indicators are susceptible to direct or indirect interference based on intentional or overt manipulation to achieve organisational goals, or inadvertent factors based on individual misunderstandings relating to reporting requirements (Bhattacharya 2011; Oswald et al. 2018). Kabir et al. (2018) suggest that leading or lagging indicators are predominantly a function of organisational compliance and they do not typically assist with the prevention of future incidents. Solomon (2015) identifies that

many organisations are moving away from displaying safety statistics across the organisation based on the premise these displays make no contribution to the improvement of safety performance.

Research on the improvement of safety performance in the oil and gas industry tends to focus on operationalising learnings from incident events. Organisations typically investigate incidents then distribute either a full report or summary of incident learnings which relies on teams and individuals to review and reflect upon (Murphy et al. 2021). Although these investigations hold the key to unlocking the cause of the event, distribution of summaries have been found to have limited effect in preventing the same or similar event occurring based on a failure of workers developing a link between the potential for harm outlined in a document and their daily activities (Dodge 2012; Elliott et al. 2012).

Catastrophic failures within the offshore oil and gas industry have caused these worksites to attract significant attention resulting in numerous high-quality investigations being conducted to examine organisational, workplace and cultural factors related to the cause of incidents. Unlike the offshore industry, onshore oil and gas has not experienced the same level of multiple fatality events leading to the onshore industry remaining relatively understudied (Martinovich 2013).

1.3. AIM OF THE RESEARCH

The aim of this research is to investigate and report on what individual characteristics present as risk factors and have the potential to cause adverse impacts on safe work performance. This investigation was guided by the conceptual model that was developed to assist in achieving the research aims and presented at section 1.6 (Elangovan & Rajendran 2015).

The opportunity to conduct a study into the risk factors that have an impact on safe work performance was facilitated by access to the personnel who are currently engaged in in oil and gas extraction activities. The primary focus of the study is to explore whether

perception of safety is positively related to safety performance in the oil and gas drilling industry or not.

Focus has been placed on the antecedents of individuals, and the impact of these factors on the perception of safety. Investigating these factors seeks to identify whether a relationship exists between the perception of safety and safe work performance.

To assist in achieving the aim of the research several propositions were considered and questions formulated to provide evidence of relationships between these factors. This involved identifying what antecedents inform worker perceptions and whether there is a relationship between worker perception of safety and safe work performance. As such, research questions to be investigated in the study are as follows:

RQ1: What individual antecedent conditions affect the perception of safety in the context of oil and gas drilling in Southeast Asia and how are they related to safety performance?

RQ2: How are the perceptions of safety related to safety performance in the context of oil and gas drilling in Southeast Asia?

These research questions remain unexamined in the context of onshore oil and gas drilling activities in the Southeast Asia region.

1.4. SCOPE OF THE RESEARCH

As onshore oil and gas drilling remains under researched. The onshore industry presents extensive opportunities for researchers to conduct novel investigations or comparative studies to generate a contemporary body of knowledge.

The scope of the research is to thoroughly investigate the antecedent factors of Southeast Asian oil and gas employees and their perceptions of safety as these factors have not been examined for the Southeast Asia regional oil and gas drilling crews. The researcher recognised that other variables including quality of materials, standards, organisational size, organisational expertise, safety leadership, training, organisational culture and union representation have previously been identified as having an impact on safety performance.

However these factors are not within the scope of this research (Wright & Spaven 1999; Prashanth et al. 2017). As this research is limited to oil and gas drilling workers in Southeast Asia caution must be exercised by others in relation to the transferability of the research to other contexts (Singh et al. 2021).

At the discretion of the researcher these variables may be included in circumstances where their inclusion contributes to the understanding of the relationship between the individual, their perception of safety and safe work performance.

Knowledge generated by this research will provide insights that have practical implications within the workplace. This knowledge is proposed to generate opportunities for organisations within the region to develop evidence-based behavioural interventions to minimise the occurrence of incidents. Understanding the antecedents that affect an individual's perception of safety is a critical insight that has not been explored within the region and will assist organisations to develop effective safety interventions based on a contemporary study of the workforce.

1.5. SETTING FOR THE INVESTIGATION

Several factors contributed to the interest in conducting this investigation. The decline in the oil and gas workforce in the previous two years as identified by the ABS (Australian Bureau of Statistics 2022a) provides credibility to the prospect of a looming skill shortage in oil and gas workers (Chopra 2020). Based on the forecast by Franza and Suryadi (2021) who state that Southeast Asian oil and gas consumption will rise at a rate of 5.8 percent per annum for the next two decades, it was considered that an opportunity existed to assist in contributing to the body of knowledge relating to oil and gas employees in the Southeast Asia region.

According to Franza and Suryadi (2021) the increased demand, particularly for natural gas is attributable to the desire to secure cleaner sources of energy driven by environmental concerns relating to air quality and greenhouse emissions. Desire for clean energy is one of the primary factors driving the replacement of coal as a source of energy. Franza and Suryadi (2021) identify solar, wind and natural gas as less environmentally harmful sources of energy

requiring an increase of the number of workers across these industries within this region to meet forecast demand over the coming decades. As a Safety Professional working within the field of work health and safety in Southeast Asia, it became evident that addressing the problem of workplace incidents and their causation required research activities to be conducted on active oil and gas drilling sites.

To meet the aim of the study, personnel who actually conduct this type of work on a daily basis provided the information is used throughout the investigation, analysis and evaluation. This parameter assisted determine the population for the study requiring participants to have a close relationship with the tasks associated with extraction of hydrocarbons through onshore drilling activities. Interaction with the workforce was considered to be essential as these people constitute the experts who could share their experiences and provide pertinent information that had the potential to address the research questions and assist with developing knowledge to reduce the gaps identified in the existing literature (Lynch et al. 2021).

The worksites where these investigations were conducted are considered to be representative to the remainder of the onshore industry with the roles and responsibilities falling into roughly the same categories across all drilling contractors, a matter that will be addressed in section 4.1.4.

Achieving the aim of the research required consideration to be given to the types of research that may achieve the objectives. As the researcher was currently engaged in the industry, it was determined that the opportunities presented to conduct research on an active oil and gas drilling rig would be utilised. When formulating the proposal for the study, the researcher developed a conceptual model identified in the following section.

1.6. CONCEPTUAL MODEL

Safe work performance may mean different things to organisations depending upon the definition used and the metrics implemented to measure it. What remains consistent in relation to safe work performance is the acknowledgement that a variety of societal, organisational, and individual factors may have an impact upon desired performance

outcomes. Authors including Hopkins (2005) indicate that safety culture is a significant contributor to safe work performance and much has been done to examine how to improve safety culture.

Solomon (2015) determined that positive associations have been identified between a healthy safety culture and safe work performance. Further studies have explored the impact of management commitment and human factors on both safety culture and safe work performance (Lingrad et al. 2014).

Human factors are those factors that involve environmental and organisational factors, individual characteristics and capabilities that can affect health and safety (Russ et al. 2013). Human factors have received varying degrees of scrutiny and have become a widely accepted model to assist in determining the causes of incidents.

Reliance on individuals performing tasks inefficiently or erroneously provides the opportunity for additional research be conducted to improve the understanding of what contributes to individual capabilities or characteristics (National Offshore Petroleum Safety and Environmental Management Authority 2015). One area within the discipline of human factors that remains unexplored relates to the relationship between antecedent conditions and their impact on both the perception of safety and safe work performance (Neal & Griffin 2006).

To achieve the aims of the research it was necessary to set down an initial framework that identified the possible courses of action that may assist in directing the study assisted by the production of an illustration (Elangovan & Rajendran 2015). Use of the conceptual model provided in Figure 2 provided a guide to the factors, information, and sample for the study.

Figure 2: Conceptual model relied upon to guiding research activities

The model assisted to guide the research process ensuring focus was maintained on the exploration of the relationships between antecedent conditions (internal and external), pre-existing perceptions and their relationship to safe work performance. The research to date focusses on relationships between individuals the organisation and safety culture (Gilbert et al. 2018). This research moves beyond existing studies to generate new knowledge related to the individual and how their inherent qualities impact on the perception of safety and performance.

1.7. SUMMARY OF RESEARCH APPROACH

To successfully conduct this research, it was concluded that several stages were required. A preliminary examination of the existing literature was necessary to understand the state of current knowledge relating to the onshore oil and gas industry in Southeast Asia and confirm this research would generate new knowledge (Hart, C. 2000; Jesson et al. 2011).

Investigations into the appropriate methodology were also conducted based on a reflective evaluation of the researchers own beliefs about the nature of truth and methodologies that were available and aligned with achievement of the research objectives (Thomas & Harden 2008).

Selection of a methodology that assisted with implementation of the appropriate data collection methods and analysis techniques. Discussions of the research findings were then to be presented along with the contributions from the conduct of this study is proposed to have had on the knowledge for the industry. An illustration of the approach is provided in Figure 3.

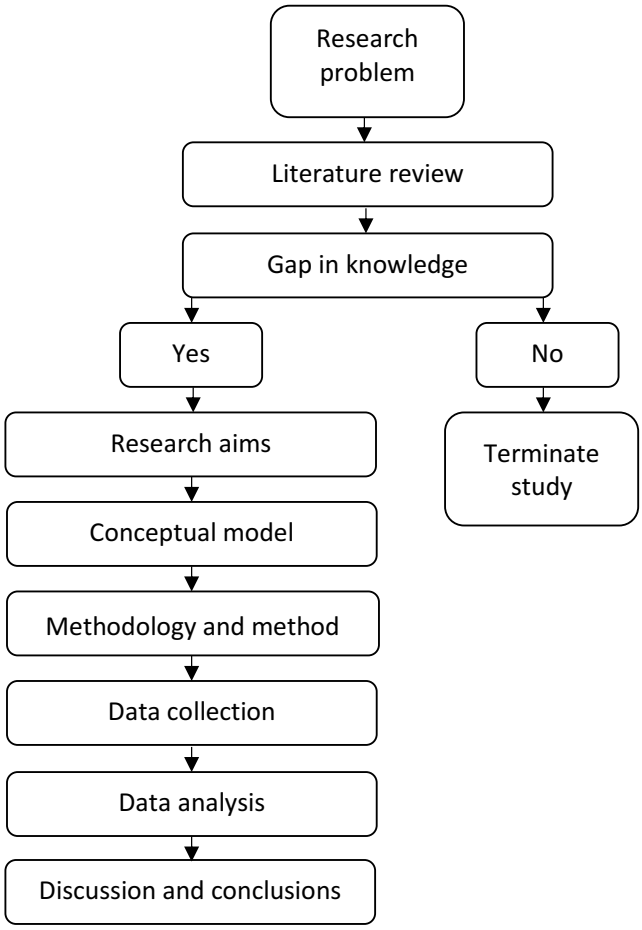

Figure 3: Research approach

Enhancing the understanding of these factors is important to increase the currently limited opportunities for employers to appreciate how individual formative experiences may carry over into their current profession and influence their safety metrics.

1.8. ANTICIPATED CONTRIBUTION OF THE STUDY

European examples of somewhat similar research are identifiable through the work of Sutalaksana and Anatasia (2016) who administered the Nordic Occupational Safety Climate Questionnaire principally designed to identify relationships between personality types and safety climate dimensions within European oil and gas drill rig workers. Sutalaksana and Anatasia (2016) identified correlations between employment categorisation (full time, part time, casual or contractor) and the respondents' perceptions of risk, commitment towards the organisational safety culture and general feelings of wellbeing within the workplace. Their study examined the influence of organisational factors on the perceptions of the