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# ***To explore and critically analyse the relationship between a worksite's perceived safety climate and its safety performance within the United Kingdom's offshore oil and gas environment.***

Author:

Keith James

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**Abstract**

This study explores how a worksite's perceived safety climate affects its safety performance in the offshore oil and gas industry in the United Kingdom. The author conducted a safety climate survey across three worksites with eight organisations participating. Each worksite's survey results were then compared to their safety performance. Finally, each worksite's results were compared to the other participating worksites to achieve the paper's aim.

Initially, a literature review explored the existing research on the topic and determined the most effective way to measure the safety climate in a high-risk workplace. This involved consulting web-based academic papers and publications.

In conclusion of the literature review, the cross-sectional Nordic Safety Climate Questionnaire (NOSACQ-50) was identified as the most appropriate measure. During correspondence with the measure's author, Dr Kines, they hypothesised that leaders score statistically significantly higher in their perception of safety climate than workers. The hypothesis was also discovered during the literature review; however, the author found opposing results in their survey.

During the literature review of the NOSACQ-50, a dimension related to safety climate and its correlation with accidents and incidents was not identified. The author included an additional dimension into their survey and formed questions based on the Health and Safety Executive - Safety Climate Tool. This dimension was crucial because it allowed cross-sectional analyses to identify relationships between worksites with and without accident and incident experience and yielded interesting findings; the worksite with the lowest safety performance and who had recently experienced a lost time incident (LTI) demonstrated the highest perceived safety climate across all eight dimensions assessed.

The outcome of the author’s research produced several findings;

Evidence would suggest that establishing a positive safety climate can increase safety performance.
In contrast, a worksite's safety performance may not reflect its safety climate, as analysis indicated the worksite with the lowest safety performance displayed the highest perceived safety climate scores. This would suggest that accidents or incidents at a worksite do not necessarily have to harm the safety climate. Moreover, with strong leadership, they can even strengthen it.

Findings would indicate the conditions preceding the incident (the prevailing safety climate) and particularly the leaders' subsequent behaviour, such as establishing root causes and not looking for guilt, which had the most significant influence on the safety climate.
According to the research, accidents and incidents can still occur in a workplace with a good safety climate, indicating that the vision of zero incidents or accidents may be unachievable. Goals of zero incidents and accidents may result in under-reporting or selective reporting of only the most severe incidents due to the fear of punishment or negative consequences, particularly when safety performance is incentivised.

Recommendations to improve safety climate and safety performance within an offshore environment included;

- Leaders should prioritise safety or strive for a balance between safety and production.
- Leaders should openly discuss safety with their workers.
- Acknowledging that eliminating accidents and incidents might be unachievable, instead focusing on improving safety climate reduces their occurrence and impact.

- Whilst dealing with accidents, incidents, and near misses, leaders should listen to their workers and focus on identifying the root causes instead of assigning blame or guilt.
- Process safety, integrated with effective personal safety management, ensures good safety performance of an organisation.
- Prioritise qualitative over quantitative measures when assessing safety performance, focusing on proactive and constant monitoring.
- Safety performance must not be incentivised, as it prevents open and honest reporting.
- The safety climate should be re-assessed every eighteen to twenty-four months, ensuring that any of the recommendations implemented have the desired effect.

It is hoped that organisations within and outside the oil and gas sector can use the research findings to measure their safety climate and improve their safety performance and overall safety culture with a focused and specific approach.

**Tables**



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3. Safety Climate Survey Poster – displayed across all three Worksites

4. Nordic Occupational Safety Climate Questionnaire – Original Paper Copy

5. Qualtrics – Electronic NOSACQ-50 with the additional Eighth Dimension

## Glossary of Terms

| | |
|---|---|
| Worksite (Ws) | Three worksites participated in the survey and were numbered Ws1, Ws 2 and Ws 3 |
| Dimension (Dim) | Eight dimensions were assessed using the Safety Climate Survey/Measure |
| Worker | A Worker is an employee or contractor on a worksite |
| Leader | A Leader includes both Supervisors and Managers |
| Nordic Occupational Safety and Climate Questionnaire (NOSACQ -50)/ NOSACQ measure | The safety climate survey was selected to test the perceptions of the worksite's safety climate. In the paper, the NOSACQ measure |

## 1.0 Introduction

### 1.1 Background

The oil and gas industry's capability to operate safely and efficiently, with acceptable risks and hazardous situations, as Bensonch et al. (2022) reported, is premonitory dependent on safety performance.

The United Kingdom's (UK) oil and gas sector originated some 58 years ago when the first commercial gas was discovered in 1965, followed four years later by commercial oil.

In 1988, the Piper Alpha disaster occurred in the same drilling environment the author is evaluating. It remains Britain's worst industrial disaster and the world's deadliest offshore accident, with the resultant loss of 167 souls losing their lives and an asset damage cost of £1.7 billion. The subsequent inquiry conducted by Lord Cullen identified serious organisational and human factor failures related to safety culture inefficiencies (Cullen, 1990). The disaster prompted the UK oil and gas sector to review safety practices and introduce new legislation, such as The Offshore Installations (Safety Case) Regulations. Since its introduction, fatalities have fallen, according to Oil and Gas UK (2009).

A study completed by Sneddon et al. (2013) found that the oil and gas sector remains one of the most hazardous industries worldwide.

Furthermore, according to Oil & Gas UK's annual 2019 report, between 1996 and 2007, there were 21 fatalities in the UK oil and gas sector. Significant improvements continued between 2007 and 2018, with only five deaths. This number is still too high with organisations striving for 'Goal Zero' (Shell, 2023) and 'Zero Fatalities' (Total Energies, 2023); however, research by Hudson

(2012) concludes the same findings but states that zero fatalities in such environments may be impossible to achieve.

Organisations operating in the offshore sector invest significant time, money, and effort into safety initiatives to measure and improve their safety performance; most do not achieve their objectives.

Safety climate, whether positive or negative, is always present in every organisation. Huang et al. (2017) identified safety climate as a strong predictor of safety behaviours or outcomes in various organisational settings. Safety climate can be measured and analysed, which can help organisations focus their safety interventions on improving safety performance and saving time, effort, and money wasted on non-specific safety initiatives. If a positive safety climate is identified, the focus should be on maintaining it.

Many measures exist to measure safety climate, originating from the Zohar Safety Climate Questionnaire (ZSCQ), established in 1980, including the Nordic Safety Climate Questionnaire (NOSACQ-50) created three decades later in 2011.

During the completion of the paper, the author corresponded Dr Kines, the author of the NOSACQ measure; Dr Kines stated that ‘leaders often have statistically significantly higher scores in their perception of safety climate than workers’. As part of the paper, the author investigated his hypothesis using the NOSACQ measure, which is well-suited for this purpose.

A dimension noted not covered in the NOSACQ-50 was accident, incident, and near-miss reporting. This dimension was seen as an essential dimension of the author’s research, allowing cross-sectional analyses of results to see if there are any relationships between those with and without injury experience. The author found difficulty in getting worksites to participate in the survey, believing that some were hesitant due to concerns about sharing information that could be seen as privileged or revealing weaknesses in their organisation. This is a potential reason for the low participation rates. If the author had been able to analyse multiple worksites within one organisation, they could have avoided this limitation. Additionally, using a single set of key performance indicators (KPIs) in the survey would make analysis quicker and more accurate, potentially leading to more reliable results.

Three worksites participated in the survey;

**Worksite 1 (Ws1) -** Consisted of four tier-one contractors on the same decommissioning and abandonment campaign, all located on the same Mobile Offshore Drilling Unit (MODU).

**Worksite 2 (Ws2) -** Consisted of a Construction Support Vessel (CSV), which supported the MODU and the project. A single Operator ran the CSV.

**Worksite 3 (Ws3) -** Consisted of three tier-one contractors on the same Mobile Offshore Drilling Unit (MODU), completing drilling and reservoir exploration activities in the UK sector.

The methodological choice for completing the survey due to the time horizon was the cross-sectional NOSACQ measure as it provided a 'snapshot' of data at a particular point in time, is quicker to complete compared to longitudinal studies, and the data was only required to be collected once from each survey participant. The reliability of the data was checked using Cronbach’s alpha, with the results for the survey displayed in an easy-to-interpret way, such as Radar Graphs, Pie charts and Line charts.

Following critical analysis of the primary and secondary research, recommendations are made, and it is hoped that organisations within and outside the oil and gas sector can use the research findings to measure their safety climate and improve their safety performance and overall safety culture with a focused and specific approach.

### 1.2 Aims

To explore and critically analyse the relationship between a worksite's perceived safety climate and its safety performance within the United Kingdom's offshore drilling environment.

### 1.3 Project objectives

The objectives of this project are to:

1. Explore existing research to define safety climate in the context of major hazard organisations, focusing on the offshore oil and gas industry.

2. Research to investigate safety climate perceptions and their potential influence on safety performance within offshore worksites.

3. Critically evaluate research findings and compare against previous research and explore the relationship between perceived safety climate and safety performance.

4. Make recommendations to improve safety climate and safety performance within an offshore environment.

### 1.4 Project Outline

The paper is organised into seven chapters, ensuring a logical flow of the research.

**1 Introduction:** This chapter introduces the research context, question, aims, and objectives.

**2 Literature Review:** This chapter explains the motivation for the project, reviews previous research completed by other academics on the research topic and justifies the author's problem-solving procedures.

**3 Methodological Approach:** Explains the methodical approach utilised during the research topic.

**4 Findings:** This chapter presents and describes the findings the research.

**5 Discussion** This chapter discusses the data findings of the primary research

**6 Conclusion:** This chapter summarises the research topic, concludes the recommendations and reflects on its completion.

**7 Recommendations:** This chapter makes recommendations on the conclusions.

# Chapter 2: Literature Review

## 2.1 Background

The primary focus of the literature review is to fulfil the first objective;

*Explore existing research to define safety climate in the context of major hazard organisations, with a focus on the offshore drilling industry.*

## 2.2 Safety Climate versus Safety Culture.

Safety climate and safety culture are concepts which researchers have extensively discussed and empirically investigated (Ashkanasy et al., 2010, Cooper et al., 2001; House et al., 2004). Although researched for over four decades, confusion still occurs, as reported by Glendon and Stanton (2000), with the concepts used synonymously and interchangeably. Mearns and Flin (1998) further say that misunderstandings exist amongst safety practitioners and researchers alike, with research by Yule (2003) supporting this statement. According to a study by Kalteh et al. (2019), safety climate and safety culture are closely linked. They also pointed out that safety climate only offers a ‘snapshot’ and is not thorough. According to additional research, Cooper (2000) was the first to present safety climate as a "snapshot" and a safety culture subcomponent.

This paper first discusses the concepts of safety culture and climate to ensure they are clearly understood. As there is no consensus on the definitions, the author will use the definitions provided by the UK Advisory Committee on the Safety of Nuclear Installations (1993) and Wiegmann et al. (2002).

## 2.2 The Concept of Safety Culture

The term 'safety culture' originated following the Chornobyl Nuclear Power Plant disaster, which occurred in 1986. Glendon and Stanton (2000) reported that it became a mainstream concept only after the investigation in which the term was cited as a causal factor by the International Nuclear Safety Advisory Group.

Safety culture has been extensively researched by academics, resulting in diverse definitions. However, a standardised definition is necessary, as Guldenmund (2000) and Hopkins (2006) highlighted. Vu and De Cieri (2014) identified 50 different definitions, emphasising the need for consistency.

The UK Advisory Committee on the Safety of Nuclear Installations (ACSNI) Human Factors Study Group (1993) provided the following definition;

*"The safety culture of an organisation is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine commitment to, and the style and proficiency of, an organisation's health and safety management."*

## 2.3 Safety Culture within the Oil and Gas Sector

Safety culture plays a defining and dominant role regarding safety performance and, in particular, accident reduction in a high-risk industry (Parker et al., 2006), with Reason (2000) describing culture within hazardous industries as the *"ability of individuals or organisations to deal with risks and hazards, so as to avoid damage or losses and yet still achieve their goals".*

Poor safety culture was cited as a causal factor in the Texas City refinery explosion, the Deepwater Horizon oil spill, and the Piper Alpha disaster.

## 2.5 The Concept of Safety Climate

Safety climate has received significant attention in studies (Sinclair et al., 2010; Liu et al., 2015), with Bensonch et al. (2022) analysing safety climate factors and safety compliance relationships in the oil and gas industry.

Over the past four decades, academics have suggested definitions for safety climate, with Zohar pioneering this field. Three decades later, Kines et al. (2011) agreed with Zohar (1980), suggesting that a safety climate is formed around working environments, safety-related policies, procedures, and practices, but more importantly, the nature of the relationship between the organisational practices 'how it is done' and an organisation's policies and procedures 'how it ought to be done' (Zohar, 2010; Zohar and Polachek, 2014).

The author favoured the definition of Wiegmann et al. (2002) as the most suitable for the paper.

*'Safety climate is the temporal state measure of safety culture, subject to commonalities among individual perceptions of the organisation. Therefore, it is situationally based, refers to the perceived state of safety at a particular place at a particular time, is relatively unstable, and is subject to change depending on the features of the current environment or prevailing conditions.'*

## 2.6 Safety Climate Measures

Much debate remains around safety climate as to whether it is a meaningful social construct whilst predicting safety-related outcomes; however, many studies have examined the relationship and correlation between positive safety climates and low incidence rates of workplace injuries and incidents, and many academics also reported increased employee participation in safety initiatives; (Ajslev et al., 2017; Barbaranelli, Petitta, and Probst, 2015; Christian et al., 2009; Feng et al., 2014; Hofmann and Stetzer, Huang et al., 2017).

Johnson (2007) concluded that developments in research methods have now established a degree of psychometric reliability and validity, and whilst reflecting on three decades of research, Zohar (2010) states the primary reflection is the achievement of validating safety climate as a robust leading indicator or predictor of safety outcomes across industries and countries.

More recent research by Huang et al. (2017) echoed that of Johnson and Zohar, stating that safety climate is one of the strongest predictors of safety behaviours or outcomes across various settings.

## 2.7 Safety Performance Indicators

As with all the attempts to define the previous ‘concepts and measures’ there remains no consensus within the literature on safety performance (Noor, 2022).

Hopkins' (2008) book on safety performance indicators is a significant addition to the discussion. The measures are considered qualitative or quantitative and provide information regarding safety behaviours or conditions, which can assist in the monitoring and developing of safety systems (Reiman and Pietikäinen, 2012).

According to De Koster et al. (2011), measuring safety performance involves assessing an organisation's ability to prevent work-related accidents, injuries, and errors by avoiding events that may result in losses. However, during the investigation into the Texas City refinery explosion, safety performance was measured by personal safety indicators, such as injury reduction and accident prevention (Hopkins, 2008), and no process safety indicators were measured. In the environment reflected in this paper and others, which are highly hazardous, crucially, measures must distinguish between personal safety and process safety.

Hopkin concluded that the statistics on personal injuries had a significant impact on the behaviour of leaders, as they were rewarded for having low accident or incident rates. This could potentially lead to them being influenced by the symbolic value of these statistics or financial gain.

In recent academic papers, there has been a change of attitude towards leading and lagging indicators; some state there needs to be more distinction, describing them as a continuum rather than two separate entities (Reiman and Pietikäinen, 2012). Other academics have suggested that the difference between leading and lagging indicators is unimportant (Hopkins, 2009; Hale, 2009, Wreathall, 2009).

Several safety performance indicators, including the following, are traditionally used within the offshore environment to measure safety performance.

### 2.7.1 Leading (or proactive)

Leading indicators measure the number of preventative actions to prevent an unwanted occurrence. Flin et al. (2000) provided examples, including using human and organisational factors to measure the safety climate, safety audits and inspections.

### 2.7.2 Lagging (or reactive)

Lagging indicators measure the number and severity of accidents or incidents (Rozendal and Hale, 2000). An organisation's reliance on the days since the last - Lost Time Incident (LTI) as a measure of safety performance is a prominent example of this in the offshore sector.
However, Kjellén (2000) argues that such indicators are unreliable as depending on how they are classified, LTI rates may give the same weight to injuries with dramatically different consequences, and the measure can be easily manipulated.

The Health and Safety Executive (HSE) - 'Guide to Measuring Health & Safety' (HSE, 2001) discusses performance indicators. They reiterate that a low injury or accident rate, even for years, does not guarantee that risks are controlled suitably. They stated that the next incident or accident could be imminent. This is particularly true in sectors where major accident hazards exist; in such environments, lagging indicators can be a deceptive measure of safety performance; preferably, proactive, and constant monitoring is a more suitable method of measuring health and safety performance (HSE 2001). Four years after the guidance was published, the Texas City disaster provided testimony to this.

During the disaster's investigation by Don Holmstrom, the U.S. Chemical Safety and Hazard Investigation Board's lead investigator, they reported that audits and inspections had identified latent conditions and deficiencies in safety systems for many years leading up to the disaster. However, the refinery focused its proactive effort towards personnel safety, such as slips, trips, and falls, rather than management systems, equipment design, and preventative maintenance programs to help prevent the growing risk of major process accidents (Holmstrom, 2005).

At the time of the disaster, Holmstrom (2005) states that the refinery had the lowest injury rate in its history, nearly one-third of the sector's average. These measures failed to account for three major accidents the previous year, each claiming a life. Their injury rate did not reflect catastrophic hazards or distinguish between injuries and fatalities. As Kjellén (2000) suggested, figures can be easily manipulated, mainly if, as Hopkins (2000) reported, management is remunerated on low accident or incident reporting rates.

Comparably, a fatality occurred at Piper Alpha in the year leading up to their disaster, which highlighted inadequacies of the permit-to-work system and the shift handover procedures, both of which Cullen (1990) established as causal factors.

Whilst discussing process industries, Hopkins (2009) stresses that there is no relationship between occupational accidents and process integrity or process safety. Hopkins provided an analogy, ‘there are no relationships between the number of casualties in the building industry and the building quality’.

The paper’s author acknowledges that personal and process safety are distinctly different topics; however, they believe their integration will improve safety performance if measured collectively. The advantage of their integration was reported by Leclercq et al. (2018), with Mataqi and Srikanth Adivi (2013) stating that good process safety, integrated with effective personal safety management, ensures good safety performance of an organisation.

### 2.7.3 Qualitative and Quantitative

In the fulfilment of this paper, the author favoured qualitative indicators whilst comparing safety performance, such as the quality of the audits completed, the gaps identified, and timely corrective actions, rather than the quantitative totals of completed audits. The justification for this approach was that it better reflects an organisation's overall safety culture; the data is of greater quality, and as previously discussed, audits and inspections had identified latent conditions and deficiencies in safety systems within the Texas City refinery before the disaster.

### 2.8 Differences in Workers, Supervisors and Management Perceptions

In correspondence between the paper's author and Dr Kines, the creator of the Nordic Occupational Safety Climate Questionnaire (NOSACQ), he wrote:

*'Leaders often have statistically significantly higher scores in their perception of safety climate than workers'.*

From the total number of responses to the NOSAQ-50 measure (89,798), Table 1 displays the Mean of all participants to the 3rd of April 2023, with the leader's dimensions (Dims) being more significant than that of the workers on all 7 Dims'.

| NOSACQ-50 dimensions | Grand mean | Standard deviation | Variance | Cronbach's alpha (reliability) |
|---|---|---|---|---|
| **Workers (n=68,855)** | | | | |
| Dim 1 - Management safety priority and ability | 3.06 | .50 | .25 | .86 |
| Dim 2 - Management safety empowerment | 2.97 | .49 | .24 | .84 |
| Dim 3 - Management safety justice | 3.00 | .50 | .25 | .80 |
| Dim 4 - Worker safety commitment | 3.18 | .47 | .22 | .76 |
| Dim 5 - Workers safety priority and risk non-acceptance | 2.99 | .51 | .26 | .77 |
| Dim 6 - Peer safety communication, learning, and trust in safety ability | 3.15 | .42 | .18 | .84 |
| Dim 7 - Workers trust in the efficacy of safety systems | 3.23 | .45 | .20 | .82 |
| **Leaders (managers & supervisors) (n=20,943)** | | | | |
| Dim 1 - Management safety priority and ability | 3.27 | .46 | .21 | .85 |
| Dim 2 - Management safety empowerment | 3.19 | .47 | .22 | .84 |
| Dim 3 - Management safety justice | 3.22 | .49 | .21 | .81 |
| Dim 4 - Worker safety commitment | 3.30 | .46 | .21 | .76 |
| Dim 5 - Workers safety priority and risk non-acceptance | 3.17 | .50 | .25 | .79 |
| Dim 6 - Peer safety communication, learning, and trust in safety ability | 3.28 | .42 | .18 | .85 |
| Dim 7 - Workers trust in the efficacy of safety systems | 3.37 | .44 | .19 | .84 |

Table 1- NOSACQ Grand Mean

The Health and Safety Executive (2000) also identified this hypothesis while working with the Keil Centre when developing the Safety Culture Maturity Model (SCMM). Their interviews produced significant differences between workers' evaluations of their organisation's level of cultural maturity and that of the leaders. The workers tended to indicate that their organisation was at a lower level of maturity than that described by their managers.

According to a recent study by Lee et al. (2023), leaders perceive the safety climate at work differently than their subordinates, as they may not fully understand the risks and hazards. However, they prioritise workplace safety, setting high standards and developing safety procedures and regulations. Workers may focus more on the gaps between what leaders promise and what is done regarding safety, which can lead to lower perceptions of the safety climate. This can result in higher safety climate perceptions among leaders and lower ones among workers.

The ten elements of the SCMM model were;

1. Management commitment and visibility
2. Communication
3. Productivity versus safety
4. Learning organisation
5. Safety resources
6. Participation
7. Shared perceptions about safety
8. Trust
9. Industrial Relations and Job Satisfaction
10. Training

Based on the data from the HSE, we can assume that management overestimates their safety performance and cultural maturity. However, this cannot be confirmed or justified without quantifiable data. One limitation the author of this paper would highlight is that, unlike other safety measures, the maturity model appears to display question bias on workers' perceptions of leaders and how they perceive their ability to deal with safety within their workplace.
Measures discussed in the next section of this paper remove such bias by including elements which measure how workers perceive their co-workers and peers whilst discussing safety performance within their workplace.

## 2.9 Measuring Safety Climate in the Offshore Environment

Other safety climate measures will now be discussed.

### 2.9.1 Zohar Safety Climate Questionnaire (ZSCQ)

Zohar was the first scholar to propose the concept over four decades ago, with their first safety climate study created in 1980 with 40 questions across eight dimensions. Zohar tested its reliability across different industries in 20 Israeli factories. The original dimensions were;

- Importance of safety training
- Effects of required work pace on safety
- Status of the safety committee
- Status of safety officer
- Effects of safe conduct on promotion
- Level of risk at the workplace
- Management attitudes toward safety
- Effect of safe conduct on social status

Many safety climate measures have used these original eight dimensions; however, methodological differences in the target populace have prevented a consistent set of core factors and definitions from being established (Flin et al., 2000).

Conversely, Seo et al. (2004) stated, following their literature review, that five original 1980 dimensions still form the basis of most safety climate measures.

- Management commitment to safety
- Supervisory safety support
- Co-worker safety support
- Employee safety participation
- Competence level

The original safety climate questionnaire was reviewed and updated by Zohar and Luria (2005) and became a 16-dimension measure using a Likert scale of 1- 7; however, whilst conducting the literature review, other Academics, such as Johnson (2007), reduced the questionnaire to 11 dimensions due to issues identified with cross-loading of factors. Despite this, the survey was psychometrically reliable, valid, and an effective predictor of safety-related outcomes of both behaviour and accident experience (Johnson, 2007).

### 2.9.2 Health and Safety Executive's - Safety Climate Tool

The Health and Safety Laboratory (HSL) developed the highly respected Safety Climate Tool (SCT) specifically for the UK's offshore drilling environment, and it has been at the forefront of understanding organisational safety culture and its impact on organisations for some time.

The SCT is an online survey with 40 statements divided into eight dimensions. Research has proven it a reliable and valid psychometric tool for assessing climate and enhancing culture.

The eight dimensions are;

- Organisational commitment
- Health and safety-oriented behaviours
- Health and safety trust
- Usability of procedures
- Engagement in health and safety
- Peer group attitude
- Resources for health and safety
- Accident and near-miss reporting

The measure's drawback is it is expensive to purchase a licence, making it unsuitable for a cross-sectional research paper over limited worksites.

### 2.9.3 Nordic Safety Climate Questionnaire (NOSACQ-50)

The NOSACQ measure is free-to-utilise and based on theory and empirical research results, capturing perceptions of conditions that contribute to individual motivation and influence relational aspects of occupational safety (Kines et al., 2011).

The Nordic Safety Climate Questionnaire was constructed within a theoretical framework consisting of 50 questions and covering seven dimensions. The survey is in two sections.

Section one establishes how employees view their managers and supervisors in terms of promoting safety in the workplace.

**1. Management safety priority, commitment, and competence**

The first dimension Kines et al. (2011) included in their climate questionnaire was around the attitude of Management, their ability towards safety and their commitment to workplace safety. Management attitude and commitment toward safety is the most assessed dimension of safety climate research (Flin et al., 2000).

Research has shown that management's safety-specific behaviours significantly impact employees' attitudes towards safety compliance and related outcomes. Hofmann and Morgeson (2004) emphasise the importance of this dimension, while Probst and Brubaker (2001) suggest that workers' perceptions of management's enforcement of safety policies at a worksite can also affect safety compliance. In fact, poor enforcement of safety policies has been found to be directly correlated with lower levels of safety compliance and an increased likelihood of workplace injuries and accidents.

### 2. Management safety empowerment

Safety empowerment is a delegation of power or trust concerning safety activities; ten studies investigated the relationship between workplace and organisational factors and injury rates. Shannon et al. (1997) examined all ten studies. They concluded that lower injury rates were reported in at least two-thirds of the studies where management safety empowerment was adopted in an organisation.

Luria (2010) investigated trust between leaders and subordinates regarding safety. According to their research, workers' faith in their leaders enhances their perception of safety climate. As a result, this creates a more secure work environment and improves safety performance.

### 3. Management safety justice

Open and honest reporting must be encouraged by leaders if a positive safety culture is desired. Employees must feel free to report errors without fear of reprise. Reason (1997), whilst discussing risk management of organisational accidents, suggested an 'informed safety culture' will improve safety performance with an element of this being a 'just culture', where employees feel confident to report errors.

The second part of the survey aims to understand how employees view their colleagues' workplace safety approach.

### 4. Workers' safety commitment

Clarke (2006) reported in their meta-analysis of 19 safety climate studies that workers' attitudes and commitments towards safety are often influenced more by their peers and workgroups than their organisations. Clarke suggested these perceptions of workgroup norms are highly decisive for group safety climate. Research by the HSE in their white paper, 'Measuring the safety climate in organisations', also cited peer pressure as one of the contributory factors of safety culture, along with attitudes, beliefs, values, taboos and perceptions.

**5. Workers' safety priority and risk of non-acceptance**

The Psychology of Risk Perception - Harvard Mental Health Letter (2011) reported that risk perception is rarely entirely rational, with people assessing risk using cognitive skills and emotional appraisals.

A safety climate assessment must ensure they question shared workers' perceptions rather than individual perceptions or personnel traits. Sjöberg (2000) included self-efficacy, stereotyping, optimism bias and individual risk behaviour as factors influencing an individual's risk perception.

**6. Safety communication, learning, and trust in co-workers' safety competence**

The dimension of perceived trust in co-workers' safety competence, including the general standard of workers' qualifications, skills and knowledge, has been a common theme in several safety climate studies. Research by Seo et al. (2004) and Flin et al. (2000) found this dimension to be one of the fifth and sixth most common themes, respectively.

Ropeik (2002) reported that trust could lower an individual's risk perception, potentially placing them at a higher risk of injury. However, this trust should be validated and not entered blindly, as over-trust could lead to undetected mistakes, such as verifying safety-critical tasks (Conchie and Donald, 2008).

Tharaldsen et al. (2010) suggest the construct of distrust is important, especially for those reasons and in high-risk industries. Even with a high level of trust, verification of safety-critical tasks should be completed with a level of distrust to ensure errors do not go unnoticed.

**7. Workers' trust in the efficacy of safety systems**

Zohar (1980) and Flin et al. (2000) concluded that adequate safety training and systems are crucial aspects of a safety climate. Safety systems include the status and effectiveness of safety advisors, the elected safety committee, and confidence in safety policies, procedures, and other safety-related arrangements. Kines et al. (2011) emphasised that safety climate is a social concept and measures perceptions of safety systems and their effectiveness in achieving high standards. As Hale (2000) suggested, it should not be an audit of the safety systems themselves.

### 2.9.4 HSE's Summary Guide to Safety Climate Tools

Previous studies have focused on safety climate and its relationship with safety performance within the offshore environment.

A summary guide to safety climate tools published by the HSE summarised, reviewed, and compared six questionnaire-based safety climate tools used in the UK offshore drilling environment, most developed in collaboration with UK oil and gas companies. The six safety climate tools that were reviewed are:

1. Health and Safety Climate Survey Tool - HSE
2. Offshore Safety Questionnaire - Aberdeen University
3. Offshore Safety Climate Questionnaire - Aberdeen University
4. Computerised Safety Climate Questionnaire - Robert Gordon University
5. Safety Climate Assessment Toolkit - Loughborough University
6. Safety Climate Questionnaire - Quest Evaluations and Databases Ltd

A core set of safety climate items were identified, which were included in all six climate tools;

1. Training and competence
2. Job security and Job satisfaction
3. Pressure for production
4. Communications
5. Perceptions of personal involvement in health & safety
6. Accidents/ incidents/ near misses
7. Perception of management commitment to health & safety - General
8. Perception of management commitment to health & safety - Specific
9. Merits of the health & safety procedures/ instructions/ rules
10. Rule-breaking
11. Workforce view on the state of safety/ culture

A key finding of their review that is relevant to all safety climate measures is a dwell time of eighteen to twenty-four, and they strongly suggest that the time interval between surveys (reassessments) should not exceed two years.

### 2.9.5 Literature Review Summary

The literature review concludes that safety climate and safety culture are often used interchangeably but are two distinct concepts. Safety climate is a measurable and tangible subset of safety culture. It provides a "snapshot" of the safety culture at a specific time. A positive safety climate at a certain point in time does not necessarily reflect a positive safety culture, which is essential for promoting safety performance and reducing accidents in high-risk industries. The literature review found that poor safety culture was cited as a factor in most offshore drilling disasters. Conversely, if a safety culture is positive, one could suggest that its safety climate subsets are positive, too.

Numerous studies explored the connection between a positive safety climate and reduced workplace accidents and incidents. In addition, many scholars have observed a rise in worker involvement in safety programs, which enhances overall safety performance. The author would suggest there needs to be a distinction between personal and process safety when accident reduction is cited.

The author would suggest that from the literature research, a positive safety climate could decrease the chances of personal accidents and incidents but might not have the same reduction in process safety. In contrast, a positive safety culture reflects safety at the organisational level, which could reduce process safety events in high-risk industries.

The research hypothesised that leaders greatly influence employees' attitudes toward safety compliance and safety-related outcomes. They often have a statistically higher perception of the safety climate than workers and believe their organisation's cultural maturity is more elevated than their workers perceive.

Management's attitude and commitment towards safety is the most assessed dimension of safety climate research and is identified as one of the strongest predictors of safety behaviours and influences safety outcomes. Poor safety enforcement and management compliance levels are correlated to an increased likelihood of incidents and accidents.

The most suitable survey to measure safety climate was identified as the NOSACQ; however, as highlighted in the literature review, a dimension not covered in the NOSACQ-50 was accident, incident, and near-miss reporting. This dimension was seen as an essential dimension of the author’s research, allowing cross-sectional analyses of results to see if there are any relationships between those with and without injury experience.

An eighth dimension was included, containing six additional questions, which were formed around those in the SCT, helping to prevent the issues identified previously concerning the ambiguous wording of questions (Conrad et al., 1999; Dillman. 2000).

The questions tested the perception of how management deals with the dimension and did not question the respondent's personal exposure to injury, which Mearns et al. (1998) did in their climate survey in the offshore sector.

## 3.0 Methodological Approach

### 3.1 Introduction

This chapter contains a description of the research methodology and discusses and justifies the research strategy and data collection techniques relevant to fulfilling the dissertation's third objective, which is:

*To critically evaluate research findings and compare them against previous research and explore the relationship between perceived safety climate and safety performance.*

### 3.2 Research Philosophy

The author conducted a literature review to analyse previously published academic works and research, explicitly searching for relevant information regarding safety climate and its impact on safety performance (as discussed in Chapter 2.0).

Web-based sources were favoured due to ease of accessibility and convenience. As the following advanced search of the term ‘Safety Climate and Safety Performance’ in the University of Strathclyde’s online library demonstrates, this is a quick and efficient method, with a search result of 8,584 Full Text online and 5,607 Peer-reviewed Journals in less than five seconds (Accessed 06/06/23) (Figure 1)).

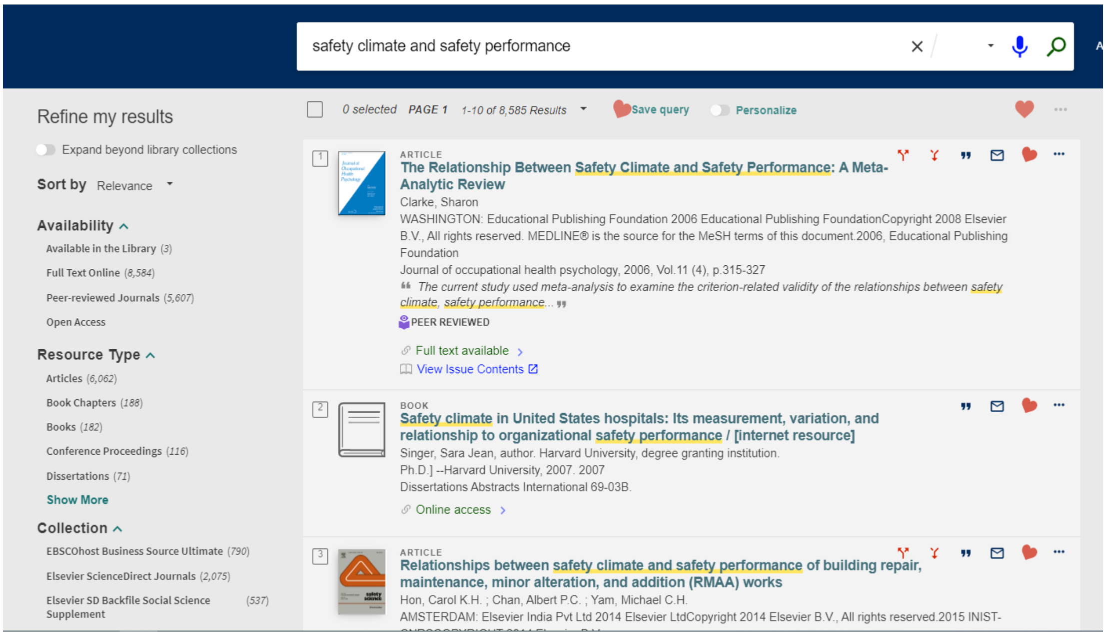



Figure 1 - Results of Strathclyde Library Search.

### 3.3 The Research Onion

To assist in demystifying research methods, Saunders et al. (2007) created the analogy of the research onion. This tool allows researchers to make choices regarding methodology and research design (Figure 2).

In analysing the research onion, the methodology followed an inductive approach with logical positivism.

Utilising the Epistemology Diagnostic Tool created by Morgan and Smircich (1980), the author was identified as an objectivist epistemologist. The methodological choice is a mono-method quantitative approach.

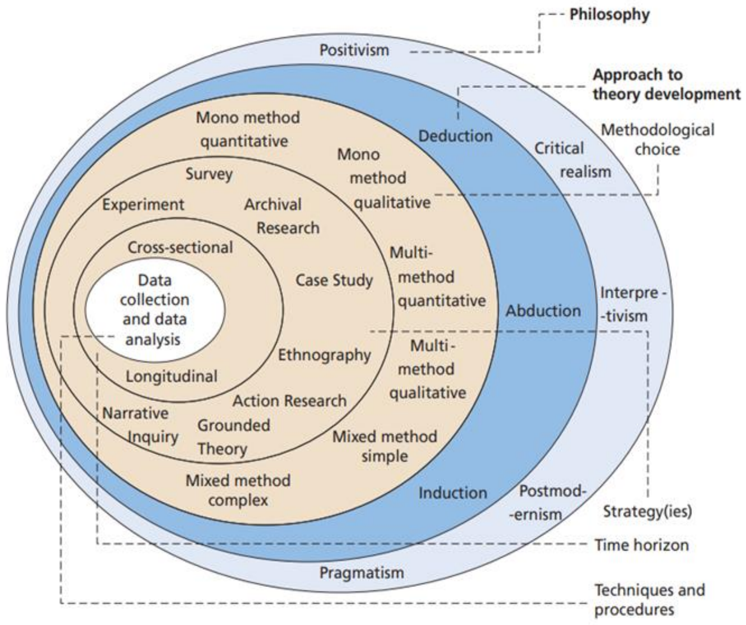



Figure 2 - The ‘research onion’.

The research onion was compared as follows:

The philosophical method identified to fulfil the objectives best was a positivist approach. This approach was chosen as it relates closely to a theory or hypothesis tested using methodological choice. Starting from the philosophy's outer layer, you must peel each layer as you choose your design method.

The approach to theory development was identified as inductive; as previously discussed, a considerable amount of research has been completed on the research aim, and the findings of the author's research were used to compare and contrast this previous academic work.

As previously identified, the methodological choice was a mono-method quantitative approach, utilising the strategy of a safety climate survey.

This research strategy approach was deemed the most suitable; whilst reviewing the literature, justifications include that this method allows the testing of hypotheses, differences in perception between groups are measured, and the choice enables the relationships between variables to be assessed.

Whilst selecting the most suitable survey, as important as the wording, is selecting a survey with the correct length (Beus et al., 2017).
A shorter survey may increase participation as it is quicker to complete with focus maintained, resulting in the submission of more complete surveys.

A longer survey that takes more time can capture a broader scope of dimensions, providing a better understanding of an organisation's safety climate. Longer surveys can also test data reliability by including negatively worded questions. The downside of a longer survey may be fewer respondents or incomplete data if the respondent loses interest or needs more time to complete it fully.
Wanous et al. (1997) report that often negatively worded questions that test data reliability can be misinterpreted as errors, resulting in adverse reactions that, if shared amongst peers, could discourage participation.

Due to the limited duration available to complete the paper, the time horizon selected was cross-sectional as it provided a 'snapshot' of data at a particular point in time, is quicker to complete compared to longitudinal studies, and the data was only required to be collected only once from each survey participant. Cross-sectional studies are comparatively cheaper, too.

The core of the onion is techniques and procedures. Initially, a questionnaire was going to be created for the research. However, the creation of a questionnaire was decided against for several reasons;

- Developing precise, unambiguous wording that permits respondents to answer the question asked successfully is problematic (Conrad et al., 1999; Dillman, 2000).

- Validating its reliability would be too time-consuming, with Flin et al. (2006) reporting that very few safety climate questionnaires have evidenced validity, with most largely failing (Brown and Holmes, 1986; Dedobbeleer and Béland, 1991; Coyle et al., 1995).

- A newly created questionnaire would have no previous research to benchmark against and no data to compare and contrast against. An established and validated questionnaire allows benchmarking data in the public domain, enabling organisations to evaluate their climate data against similar organisations (Sexton et al., 2000).

### 3.4 Safety Climate Questionnaire

As the literature identified, there are many questionnaire instruments for measuring safety climate. However, very few have proven able to present a consistent factor structure in different contexts, and many have a vague theoretical grounding (Kines et al., 2011). The NOSACQ-50 was selected for the primary research as it was the most reliable instrument for measuring safety climate and valid for predicting safety motivation, perceived safety level, and self-rated safety behaviour.

A team of Nordic occupational safety researchers developed the NOSACQ questionnaire. Kines et al. (2011) explained that it is based on organisational and safety climate theory, psychological theory, previous empirical research, empirical results acquired through international studies, and the continuous development process.

The questionnaire contains 50 items over seven dimensions or shared perceptions, which were discussed in greater detail in the literature research (Section 2) and relate to;

1. The participant's perceptions of how their managers deal with safety.
2. The participant's perceptions of how they deal with safety.

An original copy of the questionnaire (paper) and a copy exported into Qualtrics (electronic) are included in the Appendix for reference.

Each of the 50 items was answered on a Likert scale (Likert, 1932) to a four-step response, shown in Table 2, and formulated in a positive or reverse format.

Kines et al. (2011) initially selected a five-step response format for their climate questionnaire. However, following their third completed study, the middle response, "Neither agree nor disagree", was found not to be beneficial, with some respondents using the response as "I do not know"; this neutral response was removed. Kines et al. (2011) reported that the omission of the neutral response alternative reduced the problem with reversed thresholds substantially.

| | Strongly Disagree | Disagree | Agree | Strongly Agree |
|---|---|---|---|---|
| Positive Items | 1 | 2 | 3 | 4 |
| Reversed Items | 4 | 3 | 2 | 1 |

Table 2 – Four Point Likert Scale

One potential disadvantage of a Likert scale of 1 - 4 (Table 3) is that respondents may feel obligated to make a positive or negative selection, although this choice does not reflect their actual opinion. As the induction of the questionnaire states, if a participant is opposed to responding to a particular question, they may not answer.

A dimension noted not covered in the NOSACQ-50 during the literature review was accident, incident, and near-miss reporting. This dimension was seen as an essential dimension of the author's research, allowing cross-sectional analyses of results to establish if there are any relationships between those with and without injury experience.

An eighth dimension was included, containing six additional questions, which were formed around those in the SCT, helping to prevent the issues identified previously concerning the ambiguous wording of questions (Conrad et al., 1999; Dillman. 2000).

Dr Kines supported the inclusion of this additional dimension into their measure.

| | Strongly disagree | Disagree | Agree | Strongly agree |
|---|---|---|---|---|
| Accident investigation teams members are trained to identify root causes rather than blame human error. | ○ | ○ | ○ | ○ |
| People who cause accidents here are not held accountable for their actions | ○ | ○ | ○ | ○ |
| Management acts only after accidents have occurred | ○ | ○ | ○ | ○ |
| Lessons learnt are effectively disseminated to all appropriate personnel | ○ | ○ | ○ | ○ |
| I feel satisfied regard to follow-up and measures taken after injuries and accidents have taken place? | ○ | ○ | ○ | ○ |
| The crew is always given feedback on incidents that occur on this installation | ○ | ○ | ○ | ○ |

Figure 3 - The eighth dimension – questions 51 - 56

| | Dimensions | Positively Formulated Questions | Reversed Formulated Questions |
|---|---|---|---|
| Dim 1 | Management safety priority, commitment, and competence | a1, a2, a4, a6, a7 | a3r, a5r, a8r, a9r |
| Dim 2 | Management safety empowerment | a10, a11a12, a14, a16 | a13r, a15r |
| Dim 3 | Management safety justice | a17, a19, a20, a22 | a18r, a21r |
| Dim 4 | Workers’ safety commitment | a23, a24, a27 | a25r, a26r, a28r |
| Dim 5 | Workers’ safety priority and risk non-acceptance | a33 | a29r, a30r, a31r, a32r, a34r, a35r |
| Dim 6 | Peer safety communication, learning, and trust in co-worker’s safety competence | a36, a37, A38, a39, a40, a42, a43 | a41r |
| Dim 7 | Worker’s trust in the efficacy of safety systems | a44, a46, a48, a50 | a45r, a47r, a49 |
| Dim 8 | Accidents, incidents and near misses | a51, a54, a55, a56 | a52, a53, |

Table 3 – Dimensions and Question Numbers

Results are displayed using graphical displays, selected for ease of interpretation across each dimension.

A Radar chart makes two important impacts on data visualisation, as highlighted by research conducted by Mosley, H. and Mayer, A. (1999). Firstly, it is a simplified presentation of multiple performance indicators; they continue to state they are highly intuitive even to non-experts. Second, the surface area, formed by axes, can be used as a composite performance indicator. The NOSACQ-50 creators favour the Radar chart, which is prominent throughout their research literature.

Pie charts and Bar charts were the topics of a paper by Sandnes et al. (2020) - Searching for Extreme Portions in Distributions: A Comparison of Pie and Bar Charts. They concluded that most authors favour pie charts, focusing on how well they facilitate the identification of parts as a whole, whereas bar charts allow values to be identified more quickly.

### 3.5 Safety Performance of Worksites

Prior to conducting a critical analysis of the relationship between a worksite's perceived safety climate and its safety performance, firstly, the safety performance of each worksite was ranked 1st, 2nd, and 3rd. An important point to note is that the performance was only ranked on the data received by the worksite; some were more open and honest in their reporting.

Whilst establishing each worksite’s safety performance, several KPIs were used. The number of people on board at each worksite varied, with around 60, 110, and 120 individuals. This was considered when comparing results with averages taken.

- Human Factors - safety observations; the number of safety observations submitted, categorised (safe/unsafe)
- Organisational factors – Inspections/Audits
- Incident frequency rate - number and severity of accidents or incidents
- Numbers of days since a Lost Time Incident (LTI)
- Management visits to the site

### 3.6 Acknowledged Limitations

The author found the rating of worksites problematic due to the different operational and organisational factors.

- Each worksite used differing key performance indicators (KPIs), making comparison difficult; furthermore, each tier-one contractor subsequently recorded their own employee's safety performance as per their own company KPIs worksite (Ws1 x 4 companies and Ws3 x 3 companies).
- Open reporting – from the safety performance information received, it was apparent that some companies had a more open and honest reporting culture.
- One worksite is a ship that does regular 'port calls' to offload materials and collect fresh food goods – their management visit numbers were more than double due to this factor.
- Organisations have different expectations of behavioural safety observations submitted – some report low participation and high quality of those submitted. Another has a mandatory submission every two days and quality is questionable.

## Chapter 4: Research Findings

Chapter 4 presents and describes the findings of the research.

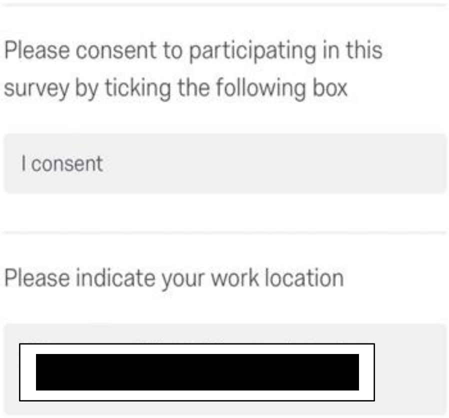
### 4.1 Safety Climate Survey

The paper's author experienced difficulties encouraging worksites to participate in the Safety Climate Survey; ten organisations were approached, with three worksites participating. Upon completing the survey, one of the worksites achieved only the minimum desired participation of twenty persons, which Kines et al. (2011) suggest is the minimum number of persons required to allow sufficient data to be analysed.

A total of 116 responses were collected, but six had to be excluded from the analysis because the consent box was not selected. The total number of participants (usable data) in the survey was 110, consisting of 58 Workers and 52 Leaders (Figure 6 and Table 5).

### 4.2 Early Limitations

Following early analysis of surveys returned via Qualtrics, it was identified that some respondents had not consented to their responses being used. This was simply an oversight as they had not selected the ‘I consent’ box (figure 4) but had completed the entire survey. Ethically, the survey responses were rejected without the consent form ticked, and the superfluous data was removed. Figure 5 displays the updated consent box. On reflection, a trial survey should have been completed, and the limitations could have been eliminated.



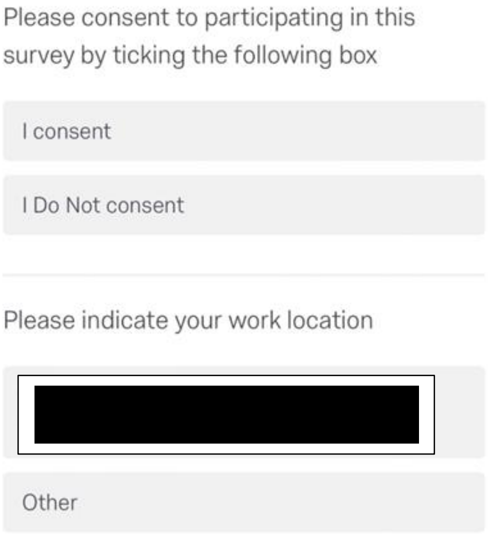




Figure 4 – Initial Consent

Figure 5 – Updated Consent

The second limitation identified was crew members explaining that they were unwilling to survey fear of reprise from management.
Assurances were made that their employing company had consented and fully supported the survey, and the ethics form attached to the email was highlighted.
The author accepted this as a limitation, suggesting that the survey could be conducted from a shared computer if any crew felt unease.

Other limitations include the fact that the survey was cross-sectional and provided a 'snapshot' of data at a particular point in time, the current climate. The snapshot could be influenced by recent non-safety-related events either negatively or positively, such as rumours of redundancies, a lack of helicopters which delay crew change dates, or the worksite securing a new or an extension to a contract, respectively.


Figure 6 – Survey Participants – Workers/Leaders Pie Chart

| Participants | % | Count |
|---|---|---|
| Worker | 52.72% | 58 |
| Leader | 47.28% | 52 |
| Total | 100% | 110 |

Table 5 – Participants Worker/Leader Percentage

### 4.3 Worksites

Three worksites participating were numbered 1 – 3 for anonymity. The employee participation numbers over the three worksites are displayed in the following bar chart (Figure 7) and expressed in percentages (Table 6).

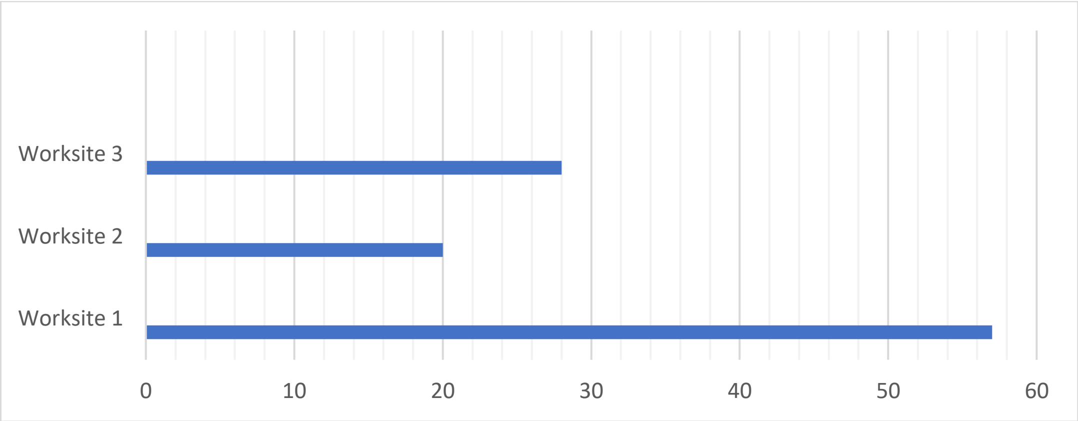



Figure7 – Worksite Participants – Percentage Bar Chart

| Worksite | % | Count |
|---|---|---|
| 1 | 56.36% | 62 |
| 2 | 18.18% | 20 |
| 3 | 25.45% | 28 |
| | 100% | 110 |

Table 6 – Participants Worksites Percentage

**4.4 Participants Demographics**

The author consciously decided to exclude demographic questions such as age and sex from the NOSACQ-50 questionnaire. This was done as it was believed that the study's purpose did not require such information, and there were no hypotheses about how demographics would impact the results (Fredrick, 2021).

Considering the potential impact of including demographics in surveys and questionnaires are essential. While it may provide valuable information, it could discourage underrepresented respondents from participating. This fear stems from concerns about being identified and experiencing discrimination or mistreatment. As a result, it could lead to less open and honest responses from underrepresented groups. Creating a safe and inclusive environment for all respondents, regardless of their demographics, is crucial.

Demographics were also considered when introducing the eighth dimension. The questions tested the perception of how management deals with the dimension and did not question the respondent’s personal exposure, something which Mearns et al. (1998) did in their climate survey in the offshore sector. Personnel questions could be perceived as a method of identifying respondents and could discourage participation.

### 4.5 Reliability of Results

The reliability of a survey may be jeopardised if respondents randomly select their responses, or in a small number of cases, individuals may intentionally choose to sabotage the survey. To ensure surveys were completed ‘honestly’ and answered with a ‘factor of reliability’, data can be analysed using Cronbach Alpha, a measure of internal consistency reliability or item interrelatedness of a scale or questionnaire (Cronbach, 1951).

According to George and Mallery (2003), Cronbach’s Alpha value;

- .900> indicates excellent internal consistency;
- .800> is good,
- .700> is acceptable,
- .600> is questionable,
- .500> is poor, and
- <.500 is unacceptable.

The author chose IBM’s Statistical Package for the Social Sciences (SPSS) to calculate Cronbach’s Alpha for each of their survey’s eight dimensions (Table 7).

**Reliability Statistics of the Author’s survey**

| Dim1 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
|---|---|---|---|
| Worker | .926 | .928 | 9 |
| Leader | .859 | .876 | 9 |
| Dim2 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .825 | .831 | 7 |

| | | | |
|---|---|---|---|
| Leader | .815 | .827 | 7 |
| Dim3 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .857 | .858 | 6 |
| Leader | .881 | .886 | 6 |
| Dim4 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .835 | .847 | 6 |
| Leader | .763 | .785 | 6 |
| Dim5 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .760 | .788 | 7 |
| Leader | .773 | .792 | 7 |
| Dim6 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .860 | .884 | 8 |
| Leader | .805 | .824 | 8 |
| Dim7 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .726 | .740 | 7 |
| Leader | .802 | .821 | 7 |
| Dim8 | Cronbach's Alpha | Cronbach's Alpha Based on Standardized Items | N of Items |
| Worker | .892 | .888 | 6 |
| Leader | .881 | .874 | 6 |

Table 7 - Cronbach’s Alpha - All Eight Dimensions

From the results, all Cronbach's Alpha values are .700 or above, indicating good reliability and data quality.

25% displays an **'acceptable'** internal consistency reliability.

69% display a **'good'** internal consistency reliability.

6% display an **'excellent'** internal consistency reliability.

### 4.6 Comparisons of Cronbach's Alpha data – the Author's survey and the international benchmark

To further test the reliability of the author's survey, the Cronbach's Alpha results of their survey were compared against the international benchmark from a database of nearly 90,000 survey responses (correct as of 3rd April 2023) as displayed on the NOSACQ-50 website (Table 7). The reliability is divided into 'workers' (n=68,855) and 'leaders' (n=20,943) survey responses, respectively (note: their results are displayed in two decimal places, compared to the author's, which is three).

| Dim1 | Cronbach's Alpha |
|---|---|
| Worker | .86 |
| Leader | .85 |
| Dim2 | Cronbach's Alpha |
| Worker | .84 |
| Leader | .84 |
| Dim3 | Cronbach's Alpha |
| Worker | .80 |
| Leader | .81 |
| Dim4 | Cronbach's Alpha |
| Worker | .76 |

| | |
|---|---|
| Leader | .76 |
| Dim5 | Cronbach's Alpha |
| Worker | .77 |
| Leader | .79 |
| Dim6 | Cronbach's Alpha |
| Worker | .84 |
| Leader | .85 |
| Dim7 | Cronbach's Alpha |
| Worker | .82 |
| Leader | .84 |

Table 7 - Cronbach’s Alpha – NOSACQ-50

- In comparing both data sets in five dimensions (Dim1, Dim3, Dim4, Dim6, Dim7) Worker and in three Leader’s dimensions (Dim1, Dim3, Dim6), Cronbach’s Alpha was more reliable in the author’s survey than the international benchmark.

- In Dim4 of the Leaders score, the author’s was equal to the benchmark.

The result of the comparison further indicates the author’s data scores, which are to the majority higher than that of the benchmark, are of high reliability.

**4.7 Worksites - Results Dimension Means**

The following figure displays the scores of the author’s safety climate survey of each of the three Worksites across all dimensions.

The range used in Figure 8 is 1.0 – 4.0; however, in Chapter 5 Discussion, to aid in-depth analysis and ease of interpretation, the range is 2.0 - 3.6 (Figure 9).

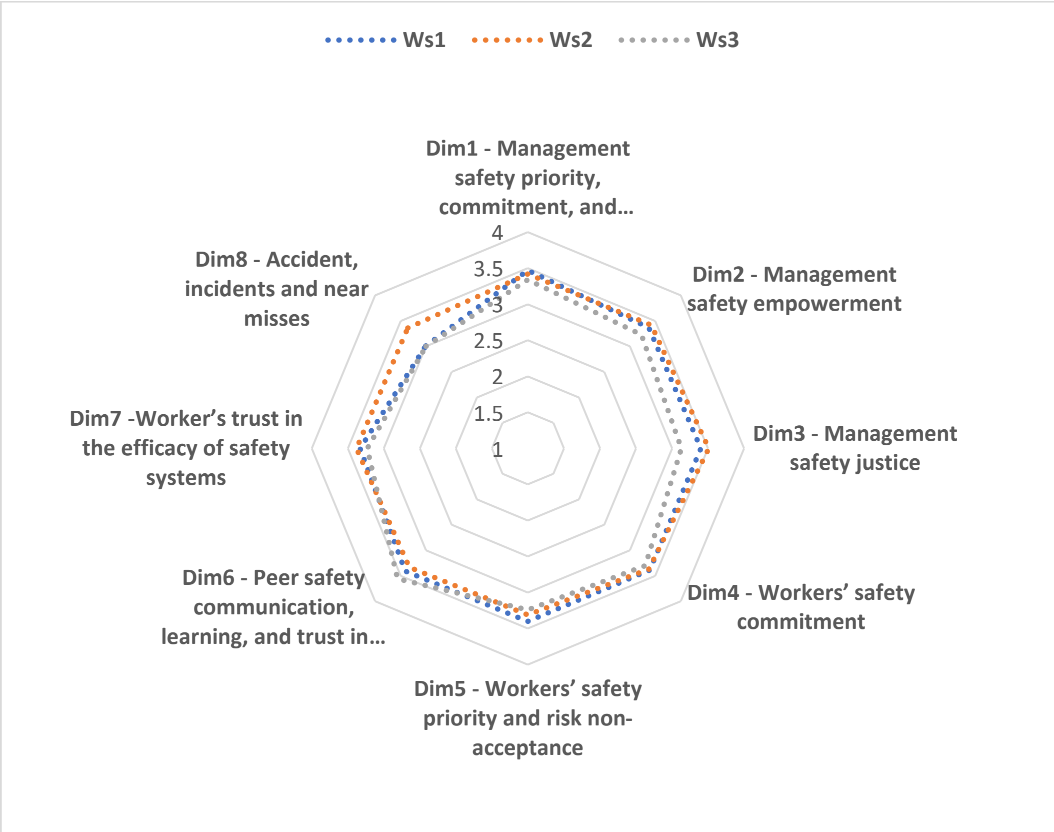



Figure 8 – Dim 1 to 8. Range 1.0 – 4.0.

Figure 8 shows very few noticeable differences, with perception scores across all worksites trending consistently.

Ws2's perception of Dim8 regarding accidents, incidents and near misses is of most interest to the author and is contrary to what might be expected from their safety performance data. This is discussed in greater detail in sub-section 5.1.

Ws3 scores slightly lower than the other two worksites in most Dims, with their perception of Managements safety justice (Dim3) the lowest; however, they perceive peer safety, communication, learning and trust in co-workers'

safety competence (Dim6) as the highest of all worksites. Further critical analysis of the results completed will follow in Chapter 5.
The following bar chart (Figure 10) displays the same data as Figure 8; however, as discussed in subsection 3.7.2 (Sandnes et al., 2020), it is provided to identify the data values in greater numerical detail.

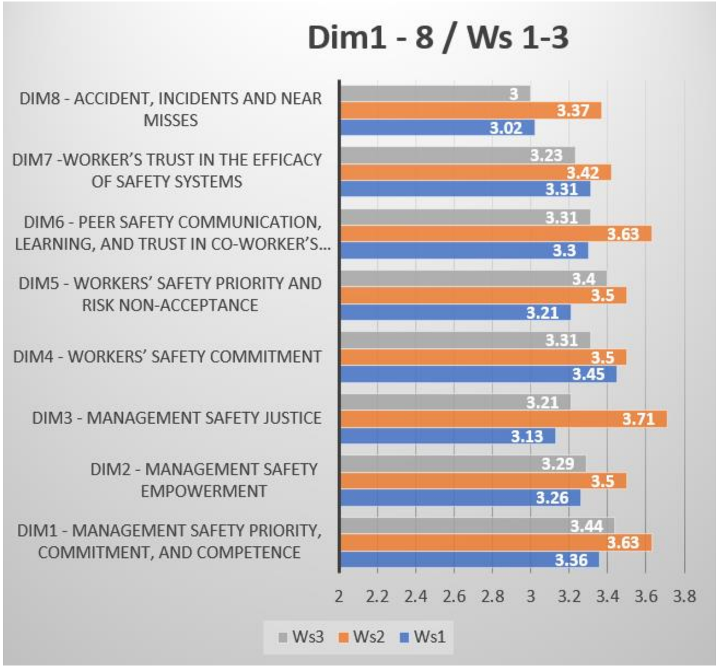



Figure 10 – Dim1-3 / Ws1-3 Results Displayed in a Bar Chart

### 4.8 Interpreting the Scores of Worksites Across All Eight Dimensions

Applying the colour coding to allow an ease of interpretation (subsection 3.8) the scores were colour coded and titled as follows;

| Range | Colour | Rating | Action Required |
|---|---|---|---|
| > 3.30 | | Good | Maintain and continue |
| 3.00 - 3.29 | | Fairly Good | Slight need for Improvement |
| 2.70 - 2.99 | | Fairly Low | Need for Improvement |
| <2.69 | | Low | Significant Improvement Required |

Table 4 - NOSACQ-50 Score Range – colour coded.

Results indicate from the 24 Dims assessed across the three worksites (Dims8 x 3Ws), 16 were suggested as good, and this level should be maintained. 8 were indicated as fairly good and needed slight improvement.

Ws2 across all Dims scored the best, with no areas for improvement identified, whereas Ws3 require a slight improvement in 5 from the 8 Dims.

Ws3 only requires slight improvement in Dim8.

| | | Ws1 Mean | Ws2 Mean | Ws3 Mean |
|---|---|---|---|---|
| Dim1 | Management safety priority and ability | 3.36 | 3.63 | 3.44 |
| Dim2 | Management safety empowerment | 3.26 | 3.50 | 3.29 |
| Dim3 | Management safety justice | 3.13 | 3.71 | 3.21 |
| Dim4 | Worker safety commitment | 3.45 | 3.50 | 3.31 |
| Dim5 | Worker's safety priority and risk non-acceptance | 3.21 | 3.50 | 3.40 |
| Dim6 | Peer safety communication, learning, and | 3.30 | 3.63 | 3.31 |

| | | | | |
|---|---|---|---|---|
| | trust in safety ability | | | |
| Dim7 | Workers trust in the efficacy of safety system | 3.31 | 3.42 | 3.23 |
| Dim8 | Accidents, incidents, and near-misses | 3.02 | 3.37 | 3.00 |

Table 8 – Mean score - All Eight Dimensions

**4.9 Differences in Worker's and Leader's Perceptions**

To test the hypothesis that 'Leaders often have statistically significantly higher scores in their perception of safety climate than workers' as discussed in subsection 2.8, all three worksites scores were combined, and then divided into workers and leaders (table 11).

| **Dim** | **Field** | **Worker Mean** | **Std Deviation** | **Leader Mean** | **Std Deviation** |
|---|---|---|---|---|---|
| Dim1 | Management safety priority and ability | 3.40 | 0.53 | 3.34 | 0.43 |
| Dim2 | Management safety empowerment | 3.36 | 0.44 | 3.22 | 0.40 |
| Dim3 | Management safety justice | 3.28 | 0.46 | 3.21 | 0.52 |
| Dim4 | Worker safety commitment | 3.42 | 0.47 | 3.38 | 0.46 |

| | | | | | |
|---|---|---|---|---|---|
| Dim5 | Worker's safety priority and risk non-acceptance | 3.33 | 0.47 | 3.31 | 0.47 |
| Dim6 | Peer safety communication, learning, and trust in safety ability | 3.38 | 0.45 | 3.33 | 0.44 |
| Dim7 | Workers trust in the efficacy of safety system | 3.30 | 0.39 | 3.30 | 0.40 |

Table 11 - Workers vs Leaders' Perceptions of Safety Climate Author's data

Although not a dimension of the NOSACQ, Dim8 is displayed in Table 12 to allow comparison.

| **Dim** | **Field** | **Worker Mean** | **Std Deviation** | **Leader Mean** | **Std Deviation** |
|---|---|---|---|---|---|
| Dim8 | Accidents, incidents and near misses | 3.10 | 0.62 | 3.00 | 0.68 |

Table 12 - Workers vs Leaders' Perceptions of Safety Climate Dimension 8

### 4.10 International Benchmarking

Analysis was conducted between the author's findings and the international benchmarks provided by Dr Kines for the energy sector (Table 13). Although interesting results were displayed, indicating greater perception scores in the author's surveys, the research did not directly correlate to the research Aim. The results of the analysis are shown in the annexe for reference only.

| | **Survey** | **Benchmark** |
|---|---|---|
| **Dim1 -** | 3.38 | 3.29 |
| **Dim2 -** | 3.29 | 3.18 |
| **Dim3 -** | 3.25 | 3.33 |
| **Dim4 -** | 3.41 | 3.32 |
| **Dim5 -** | 3.32 | 3.20 |
| **Dim6 -** | 3.42 | 3.33 |
| **Dim7 -** | 3.31 | 3.40 |

Table 13 - International Benchmark and Author's Survey Scores

## 5.0 Discussions

Chapter 5 will critically evaluate the research findings, compare them against previous research, and explore the relationship between perceived safety climate and safety performance. It will also test the hypothesis identified during the literature review that leaders perceive safety climate as greater than their employees.

As mentioned in section 4.6, Ws2 had a higher perspective of Dim8 - accidents, incidents, and near misses, as shown in Figure 9. It is noteworthy that Ws2 achieved their lowest survey score of 2.5 of all 56-survey question in this area (a52r). Regardless of their lowest score, their perception of Dim8 remained higher than Ws1 and Ws3. Each Dim is analysed further by individual survey question, with Dim 8 displayed in Figure 18.

Other notable differences in Figure 9 include, Ws3 scores slightly lower than the other two worksites in most Dims, with their perception of Managements safety justice (Dim3) the lowest; however, they perceive peer safety, communication, learning and trust in co-workers' safety competence (Dim6) as the highest of all worksites. Further critical analysis of the results continues next in this Chapter (Sub-section 6.1), with each Dim being display in individual Radar graphs.

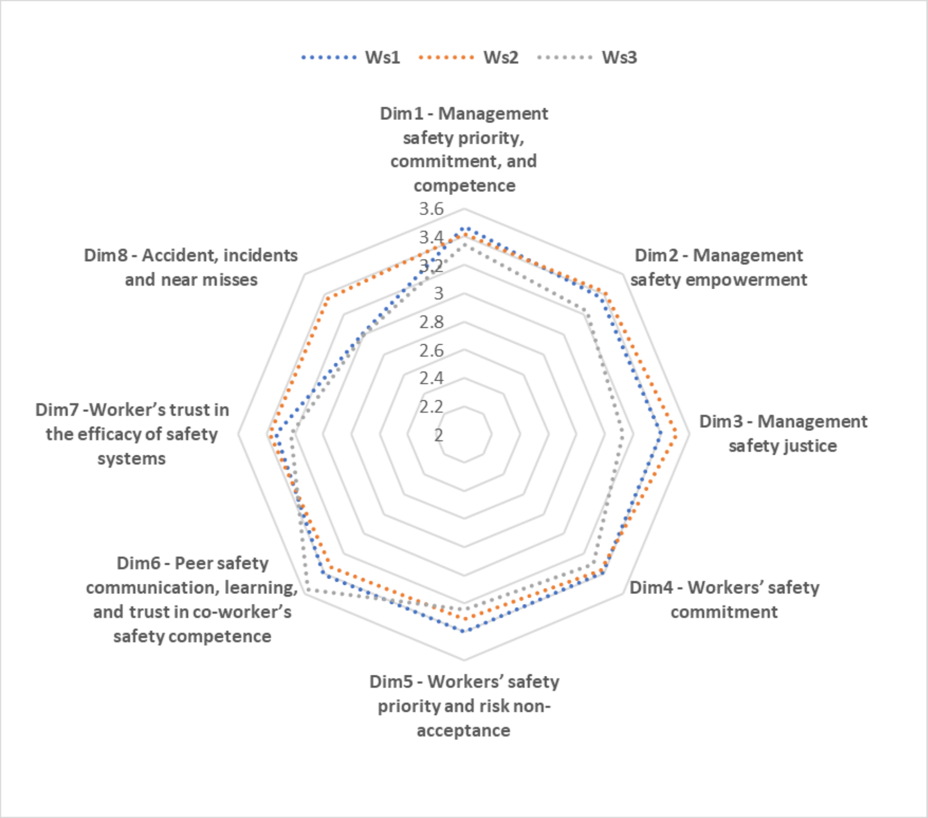



Figure 9 – Dim 1 to 8. Range 2.0 – 3.6

### 5.1 Perceived safety climate and safety performance

The following subsection will explore the eight dimensions in greater detail, critically analysing each worksite's perceived safety climate and comparing it against their reported safety performance. Safety performance was discussed in sub-section 3.7, and to facilitate analysis between worksites, they were numerically rated from the best – poorest performance, Ws1, Ws3, and Ws2, respectively.

Workers and leaders are no longer differentiated, and Radar graphs continue to be used with a scale of 2.0 – 4.0.

**Dim 1: Management Safety Priority, Commitment, and Competence**
(Figure 11)

Despite having the lowest safety performance among all worksites, Ws2 has the highest perception of safety climate in all nine questions. This contradicts the suggestion by Probst and Brubaker in 2001 that poor safety enforcement and lower compliance with safety policies lead to increased workplace injuries and accidents (poor safety performance).

Ws2 reported that management prioritised safety over production (a4). Although Ws1 and Ws3 had better safety records, they received a lower score of 3.0 on the survey question compared to Ws2's score of 3.5. Management should prioritise safety or balance safety and production to improve the overall safety climate.

Ws1, who reported the best safety performance, performed poorly in all questions, except for a3, regards ‘management looking the other way’, to which they disagreed and were tied top performers with Ws2. Interestingly, their perception was only higher than Ws3 in this survey question.
Ws2 reported significantly higher scores on their perception of how managers deal with safety (a6) and subsequently correct safety issues identified (a7).

Ws3’s perception of safety climate came second in five survey questions and joint second in three survey questions with Ws1.

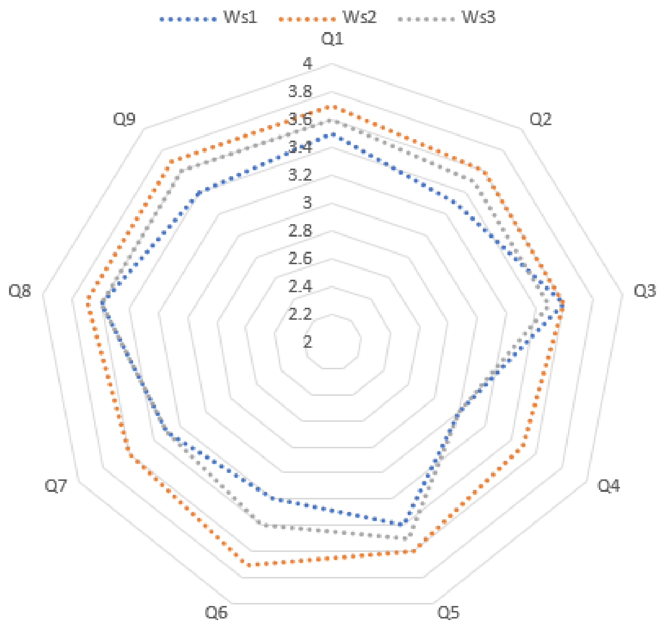



Figure 11 – Management Safety Priority, Commitment, and Competence Radar Chart

**Dim 2: Management Safety Empowerment**
(Figure 12)

All Worksites displayed a good level of safety climate perception in this Dim, with all scores greater than 3.0.

Ws2 once again performed the strongest across all questions, noticeable regarding Management influencing safety in their work environment (a11) and involving employees in safety decisions (a16). Ws1, as per Dim1, came last or joint last in all but one question (a12), secondly to Ws2.

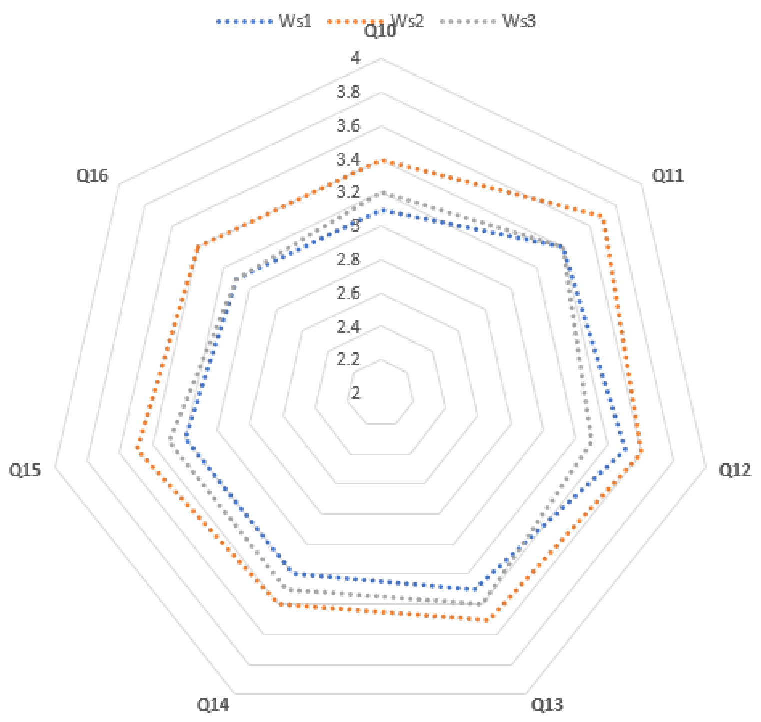



Figure 12 – Management Safety Empowerment Radar Chart

**Dim 3: Management Safety Justice**

(Figure 13)

The trend of Ws2 outperforming both other worksites continue in Dim3 and, to a greater degree, across all questions. The most significant variance in perception, with a 0.8 difference, was around management looking for root causes rather than blaming employees following accidents (a20). This is an interesting observation, especially as Ws2 displayed the poorest safety performance, with one of the contributing factors to this being the worksite recently experiencing an accident.

One could perceive from the results that this reflects how management dealt with the LTI and is reflected in Ws2's positive responses in Dim1 and Dim2. Regardless of a recent loss-causing event the safety climate is greater than those who report a long and successful period of no accidents or incidents.

The reported best safety-performing worksite (Ws1) remains joint or last in all survey questions (a19, a20, a22).

To improve a safety climate, leaders should listen to their employees, look for root causes of accidents and not look to apportion blame.

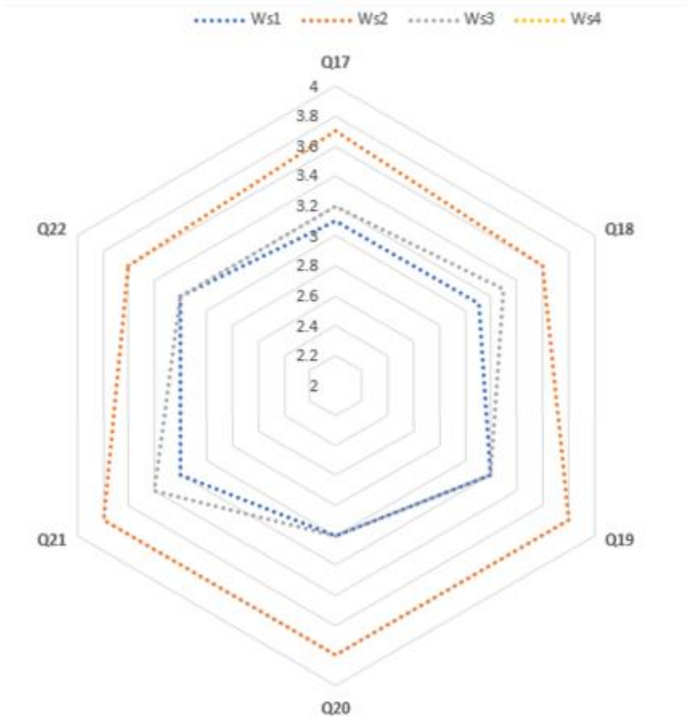



Figure 13 – Management Safety Justice Radar Chart

**Dim 4: Workers' Safety Commitment**
(Figure 14)

Dim4 was the first dimension that looked at workers' perception of their peers towards safety.
Based on the scores for most survey questions, it appears that Ws2 has a very positive climate towards workplace safety and employees. They demonstrate joint responsibility for maintaining a tidy workplace, as evidenced by their scores being 0.7 and 0.5 higher than other participating worksites.

In the survey, all questions received a good rating except for one (a26r), which was phrased confusingly. The question asked whether employees avoid dealing with discovered risks, but this wording could be interpreted in different ways. In a high-risk industry, it is impossible to avoid all risks, but they are assessed and reduced as low as practicable. If the risk is unexpected or new, it must be avoided at first to evaluate it properly. Depending on how the question was interpreted, respondents may have answered differently. Another potential influence on the response could be a risk-taking culture, which reflects the 'hegemonic masculinity' prevalent on a remote UK Offshore Drilling Platform (Adams 2023), whereas Ws2 is a construction vessel – staffed primarily with Maritime crew.

All the participants shared a common perception regarding question 28r, which involved taking responsibility for each other's safety. The question received a score of 3.60 from all Ws.

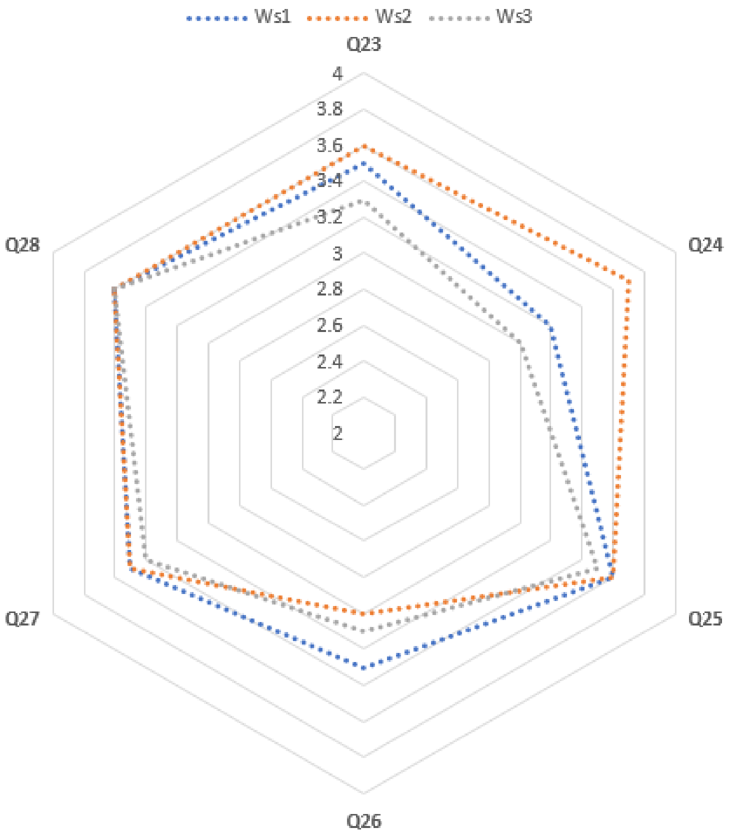



Figure 14 – Workers' Safety Commitment Radar Chart

**Dim 5: Workers' Safety Priority and Risk Non-Acceptance**
(Figure 15)

Question 33 displayed the lowest perception score across this Dim, 'we who work here never accept risk-taking even if the work schedule is tight' (a33) and was identified as an unreliable survey question. According to Dr. Kines, who corresponded with the author, the item is poorly worded with double negation, which often causes confusion and is a recurring issue in most studies.

Shabanov, Y. and Shetreet, E., in their research 'The scalar interpretation of double negation' – suggested double negations are challenging to interpret and are often used as mitigation (i.e., not unhappy means happy). The author would challenge Dr Kines justification and does not feel an issue is a double negation; alternatively, rationalising that a33 is the only positively formulated survey question in the Dim (Table 9), which Sonderen et al. (2013) suggest could flaw the data due to respondents' inattention or confusion of wording.

| | Dimensions | Positively Formulated | Reversed Formulated |
|---|---|---|---|
| Dim 5 | Workers' safety priority and risk non-acceptance | a33 | a29r, a30r, a31r, a32r, a34r, a35r |

Table 9 - Dimensions Eight and Item Numbers

Across all other questions, Ws2 performed best, only being outperformed on one question regarding work being suitable for cowards (a34r) and potentially reflecting the 'hegemonic masculinity' discussed in Dim4 (a26r).

Question 34 was the only NOSACQ-50 survey question (Dim 1-7) where Ws2 did not receive the highest score rating or joint top.
Survey question 32, tested the perception of rule-breaking to complete a deadline and was strongly disagreed with by Ws2 and Ws1 (both 3.7), whereas Ws1 requires slight improvement (3.2).

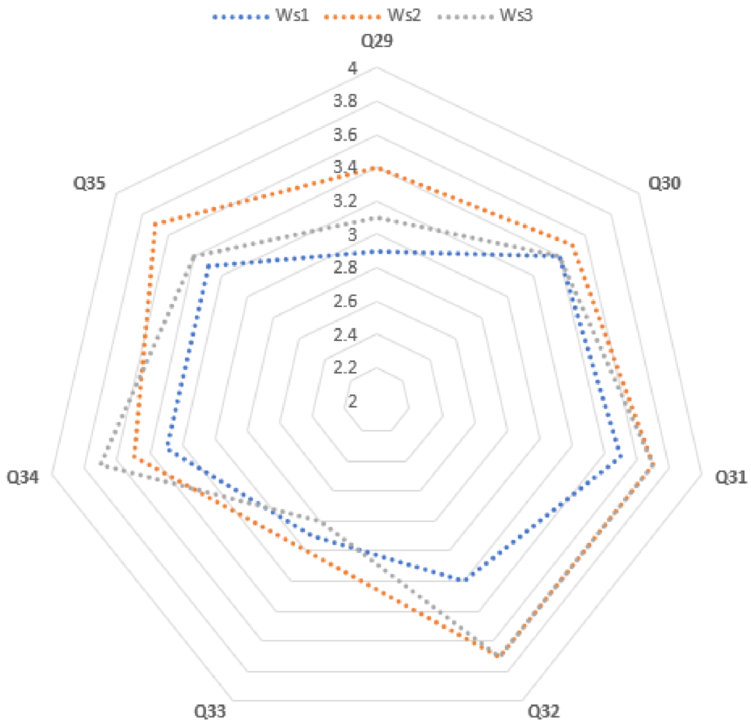



Figure 15 – Workers' Safety Priority and Risk Non-Acceptance Radar Chart

**Dim 6: Peer Safety Communication, Learning, and Trust in Co-Worker's Safety Competence**

(Figure 16)

In this Dim, Ws2 and Ws3 achieved a rating of 'good' across all survey questions, Ws1 requires slight improvement in 4 questions (a37, a38, a39, a41r).

Ws2 displays a much higher perception of their safety climate than the two other Ws. Ws3 report a higher perception of feeling safe and having trust whilst working together, learning from experience, and often talking about safety than Ws1 (a37, a38, a39, a41r).

Though Ws1 reports a higher perception of finding solutions, taking each other opinions seriously and regularly discussing safety (a36, a40, a42, respectively). Ws1 and Ws3 both achieved the same 'good' rating (3.4) regarding talking openly and freely about safety.

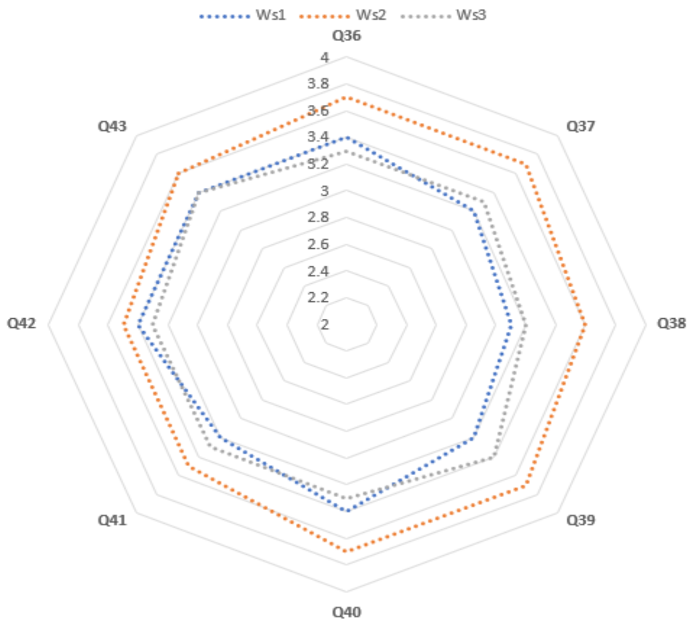



Figure 16 – Peer Safety Communication, Learning, and Trust in Co-Worker's Safety Competence Radar Chart

**Dim 7: Worker's trust in the efficacy of safety systems**
(Figure 17)

Within this dimension, Ws1 had a greater perception of safety climate than Ws3; however, as all with the previous six Dims analysed, Ws2 scored higher in 4 questions (a44, a45r, a46, a48) and equal to Ws1's in 3 questions (a47r, a49r, a 50).
In one question, regards the effectiveness of safety training, all three Ws scored 3.5.

Ws2 achieved good rating over the entire Dim, whereas Ws1 and Ws 2 achieved a combination of fairly good and good – still good scores overall.

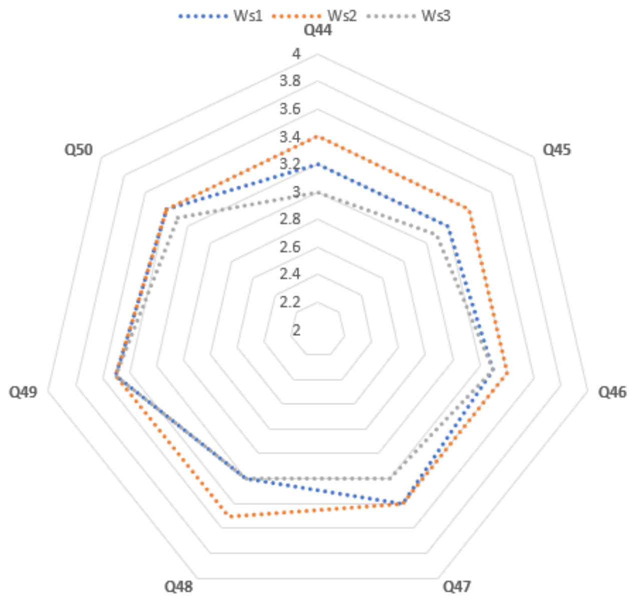



Figure 17 – Worker's trust in the efficacy of safety systems Radar Chart

**Dim 8: Accidents, incidents and near misses** (Figure 18)

In one survey question, Ws2 received its lowest perception score of 2.5 '*People who cause accidents here are not held accountable for their actions'* (a52r) and was the only question where they did not receive the highest or joint highest rating. The question asked whether people who cause accidents are held accountable for their actions, and the response was inconsistent with the rest of the survey.

The author verified the score and suggested that it may be due to a double negation or a poorly worded question. As the question was negatively worded, as Wanous et al. (1997) reported, it could have simply been misinterpreted, with respondents mistaking it for a similar question in Dim3 (a20), *'management looks for causes, not guilty persons, when an accident occurs'* which tested the perception of blame culture and received the survey's highest score of 3.8.

If the question was misinterpreted, Ws2 would have performed well in Dim8 and should continue to maintain its performance.

Both Ws1 and Ws3 require some degree of improvement throughout Dim8.

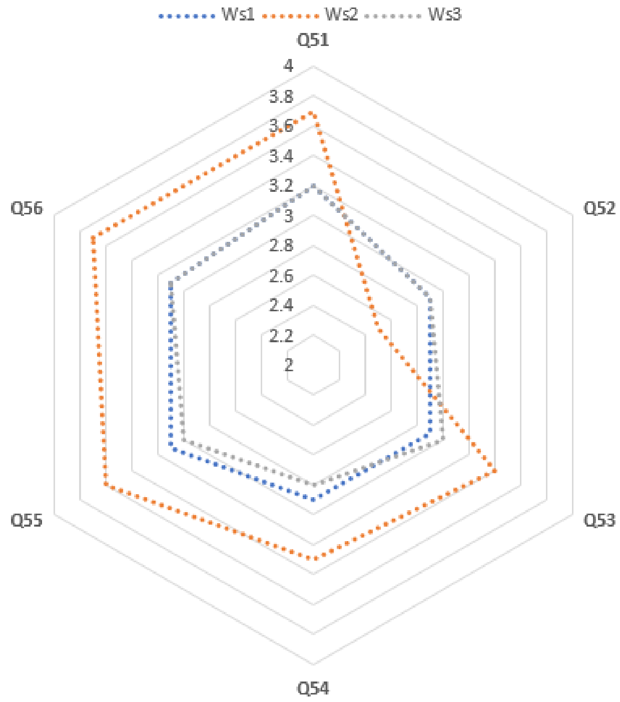



Figure 18 – Accidents, incidents and near misses Radar Chart

### 5.2 Workers vs Leaders' Perceptions of Safety Climate

As discussed in sub-section 2.8, it is hypothesised that leaders often have a statistically higher perception of safety climate than workers and believe their organisation's cultural maturity is more elevated than perceived by their workers.

The following data (Table 10) is displayed on the NOSACQ-50 website and provides dimension means based on the international data in their current database. The Means are for responses from 'workers' (n=68,855) and 'leaders' (n=20,943).

| Dim | Field | Worker Mean | Std Deviation | Leader Mean | Std Deviation |
|---|---|---|---|---|---|
| Dim1 | Management safety priority and ability | 3.06 | .50 | 3.27 | .46 |
| Dim2 | Management safety empowerment | 2.97 | .49 | 3.19 | .47 |
| Dim3 | Management safety justice | 3.00 | .50 | 3.22 | .49 |
| Dim4 | Worker safety commitment | 3.18 | .47 | 3.30 | .46 |
| Dim5 | Worker's safety priority and risk non-acceptance | 2.99 | .51 | 3.17 | .50 |
| Dim6 | Peer safety communication, learning, and trust in safety ability | 3.15 | .42 | 3.28 | .42 |
| Dim7 | Workers trust in the efficacy of safety system | 3.23 | .45 | 3.37 | .44 |

Table 10 - Workers vs Leaders' Perceptions of Safety Climate NOSACQ-50 data

In all seven Dimensions (Dim1-7), the Leader's perceptions Mean are higher than the Worker’s, supporting the hypothesis.

The following table displays the Mean of the author's survey.

| Dim | Field | Worker Mean | Std Deviation | Leader Mean | Std Deviation |
|---|---|---|---|---|---|
| Dim1 | Management safety priority and ability | 3.40 | 0.53 | 3.34 | 0.43 |
| Dim2 | Management safety empowerment | 3.36 | 0.44 | 3.22 | 0.40 |
| Dim3 | Management safety justice | 3.28 | 0.46 | 3.21 | 0.52 |
| Dim4 | Worker safety commitment | 3.42 | 0.47 | 3.38 | 0.46 |
| Dim5 | Worker’s safety priority and risk non-acceptance | 3.33 | 0.47 | 3.31 | 0.47 |
| Dim6 | Peer safety communication, learning, and trust in safety ability | 3.38 | 0.45 | 3.33 | 0.44 |
| Dim7 | Workers trust in the efficacy of safety system | 3.30 | 0.39 | 3.30 | 0.40 |

Table 11 - Workers vs Leaders' Perceptions of Safety Climate Author’s data

The author's survey (Table 11) revealed that the workers perceived their safety climate as either higher or equal (Dim7) to that of the leaders in all dimensions, which was unexpected and contrary to the hypothesis (Lee et al. 2023).

The author's results for the additional Dim8 – ‘Accident, incidents and near displayed the same trend (Table 12) of workers perceiving their safety climate as higher than their leaders.

| Dim | Field | Worker Mean | Std Deviation | Leader Mean | Std Deviation |
|---|---|---|---|---|---|
| Dim8 | Accidents, incidents and near misses | 3.10 | 0.62 | 3.00 | 0.68 |

Table 12 - Workers vs Leaders' Perceptions of Safety Climate Dimension 8

After analysing the results of the author's surveys (table 11), it has been found that the differences in mean scores are higher but not significant. The only noteworthy difference was that workers perceived their safety climate as 0.14 higher than leaders (Dim2).

However, when looking at the NOSACQ-50 figures (table 10), it was found that the greatest difference was that leaders perceived their safety climate as 0.22 greater than workers (Dim2 and Dim3).

Interestingly, Dim2 of the author’s survey, which observed the greatest difference (0.14), indicates leaders have a lower perceived score of their own safety empowerment than their employees (figure 19).

The secondary research identified many articles supporting the hypothesis (Mearns et al. 2001, Findley et al. 2007, Lee et al. 2023); however, no articles were found to supported or explained the author's findings.

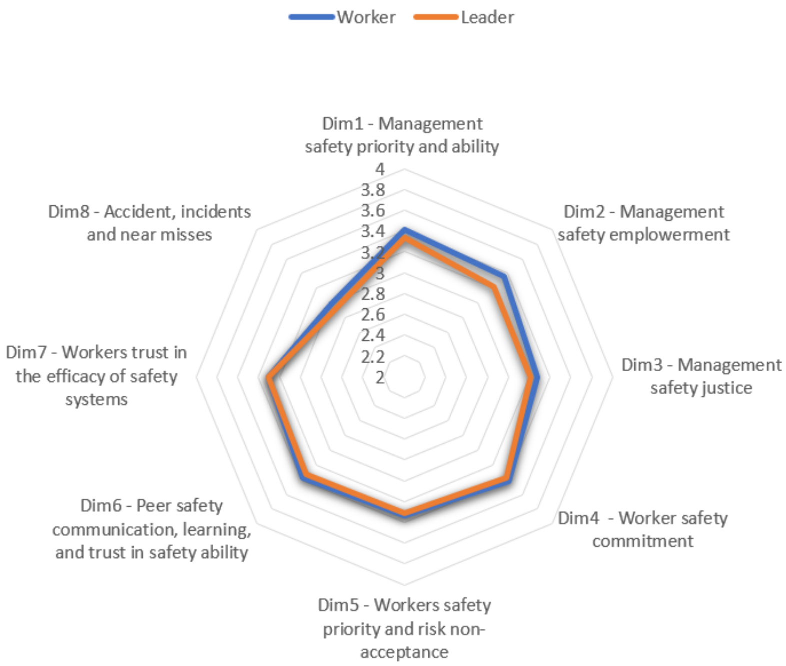



Figure 19 – Workers and Management's Perceptions Radar Chart

### 5.3 Accidents, Incidents and Near-misses

In the author's analysis of an additional dimension, Dim8, which pertains to the perception of safety climate and its correlation with accidents and incidents, it was discovered that the worksite (Ws2) with the lowest safety performance, which had a Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 2013 reportable incident a month before the survey commenced was the only worksite that required no improvement.

According to Wiegmann et al. (2002), the safety climate is unstable and can change depending on the current environment or conditions, which makes it surprising that the recent accident did not negatively influence the survey responses and perception of Dim8, one could surmise from the findings, it had the opposite effect.

The literature review indicated that a positive safety climate could improve safety performance, including reduced accidents and incidents. However, the survey results reveal that a negative safety performance does not necessarily reflect a poor safety climate. Other factors that could impact the perception of a safety climate include variations in how safety performance is categorised, the underlying causes of accidents, and the severity of injuries, management's response, among others.

**5.4 Discussion Summary**

The research findings have been interpreted across the three worksites and would indicate no relationship between their perceived safety climate and the reported safety performance of the participating worksites.

The 'highest' reported safety performing worksite (Ws1) showed a need for slight improvement across 4Dims (Dim2, Dim3, Dim5, Dim8) with the lowest Mean across all 8Dims of 3.25.
Ws3 reflected Ws1's slight need for improvement across 4Dims (Dim2, Dim3, Dim7, Dim8); their Mean was 0.02 higher at 3.27.
Whereas the 'lowest' safety performing (Ws2) achieved 'good' in all 8Dims and should 'continue and maintain' their current safety focus. Their Mean was 3.53.

The paper also tested the hypothesis that Dr Kines introduced to the author: Leaders have a statistically higher perception of safety climate than Workers. Although Dr Kines research will support this hypothesis, the author's research does not. Worker's safety climate perception was greater across all eight Dims, which is positive for the participating worksites and could be seen as a positive cultural indicator.

The additional dimension introduced into the survey (Dim8) tested the perception of the safety climate following an incident or accident. One would consider such a loss-causing event to have a negative effect; however, the worksite that reported the lowest safety performance and the occurrence of a RIDDOR reportable incident performed the best and was the only worksite that required no improvement.
Question a52r was the worksite's lowest perceived score; however, the author believes this was in error, as a similar question regards blame culture (a20) achieved the worksites highest score (3.8).

The author considers the effects of a loss-causing event on safety climate to be the most noteworthy discovery of the paper and suggests that it is worth exploring further as a separate research topic.

The outcome of the author’s research produced several findings;

Evidence would suggest that establishing a positive safety climate can increase safety performance. Conversely, a worksite's safety performance may not reflect its safety climate, as analysis indicated the worksite with the lowest safety performance displayed the highest perceived safety climate scores.
This would support the findings in Dim8 that accidents or incidents at a worksite do not necessarily have to harm the safety climate. Moreover, with strong leadership, they may even strengthen it.
Findings would indicate the conditions proceeding the incident (the prevailing safety climate) and particularly the leaders' behaviour following, such as looking for root causes and not guilt, had the most significant influence on the safety climate.

As highlighted, accidents and incidents can still occur in a workplace with a good safety climate, indicating that the vision of zero incidents or accidents may be unachievable. Perfect visions may result in under-reporting or selective reporting of only the most severe incidents due to the fear of punishment, negative consequences or when safety performance is incentivised.

Safety climate is a temporal state of safety culture (Wiegmann et al. 2002), reflecting a safety culture at a specific time. Positive safety culture is recognised to play a defining and dominant role concerning safety performance and, in particular, accident reduction in a high-risk industry (Parker et al., 2006); however, in the author's research, the worksite with the lowest safety performance displayed the highest perceived safety climate. The research indicates that accidents and incidents are inevitable, and a goal of 'zero' is unachievable, even with the most robust controls; unfortunately, incidents occur. As an industry, reducing severity is a sound risk control strategy. The research indicates that the management's response is the most crucial influence on the climate if an incident occurs. A positive response by leadership has strengthened the climate, gaining the trust and respect of their employees. If leadership had displayed a 'blamed culture' the author suggests, an adverse effect would have been observed.

### 5.5 The Missing Dimension

A dimension identified to be missing from the NOSACQ-50 was the perception of safety climate and its relationship with accidents and incidents causation. This additional dimension of six questions based on the Health and Safety Executive’s - Safety Climate Tool was included into the research questionnaire. It could be argued that a 56 items questionnaire is too onerous to complete; however, two work sites only achieved the minimum desired participation of 20 employees, which Kines et al. (2011) suggested is the minimum number of employees required to allow sufficient data to analyse. If the questionnaire had been shorter, the author feels the quality of data submitted could have been reduced quality or of an insufficient amount and would have prevented critical evaluation. Nonetheless, the author does recognise that the low number of participants could have also been due to the length of the questionnaire. If additional surveys are to be completed, which encompass a more significant number of worksites and participants, the questionnaire could be tailored with the permission of Dr Kines.

A significant limitation, as previously mentioned, was gaining permission from organisations to run the safety climate survey. At one point, the lack of organisations willing to participate threatened the paper's completion, resulting in a six-month deferral period to capture sufficient quality data.

Secondly, even when organisations agreed to participate and with management sponsorship of the survey, participation levels could have been higher, especially in the two work sites where the author was not directly employed.

Potential areas of improvement have been established and will be discussed in the following chapter.

## Chapter 6: Conclusion

The research explored and critically analysed the relationship between a worksite's perceived safety climate and its safety performance within the United Kingdom's offshore oil and gas environment.

Initially, a literature review explored the existing research on the topic and determined the most effective way of measuring the safety climate in the high-risk workplace under consideration. This involved consulting academic papers and publications.

The secondary research concluded that safety climate and safety culture are often used interchangeably but are two distinct concepts, with safety climate being a measurable and tangible subset of safety culture. It provides a "snapshot" of the safety culture at a specific time (Cooper 2000).
Many surveys exist to measure a safety climate; the literature found the NOSACQ-50 as the most suitable measure; Kines et al. (2011) stated it could capture perceptions of conditions that contribute to individual motivation and influence relational aspects of occupational safety. A dimension noted not included in the NOSACQ-50 was accident, incident, and near-miss reporting. An eighth dimension was created and included, which was essential to the author's research, allowing cross-sectional analyses of results to establish relationships between those with and without injury experience.

The primary research produced some interesting findings, opposing the secondary research discovered in academic papers.

Secondary research suggested that establishing a positive safety climate can increase safety performance, whereas, in the author's survey, the worksites with the poorest safety performance displayed the highest perception of safety climate across all worksites. Several possible reasons exist for the observed difference in safety performance among worksites. It could be due to data quality variations, the key performance indicators used to measure safety, or even data manipulation to show a better safety record.

The hypothesis identified during the secondary research that *‘Leaders often have statistically significantly higher scores in their perception of safety climate than workers’* was also found to be untrue in the three worksites assessed. During the secondary research into the hypothesis, no data was discovered that supported the authors finding, which was contrary to the hypothesis.

In contrast, a worksite's safety performance may not reflect its safety climate, as analysis indicated the worksite with the lowest reported safety performance displayed the highest perceived safety climate scores, suggesting that accidents or incidents do not necessarily damage a safety climate. Moreover, a safety climate could be improved with strong proactive leadership.

## 7.0 Recommendations

From the conclusions, the following recommendations are made to improve safety climate and safety performance within an offshore environment.

- Leaders should prioritise safety or strive for a balance between safety and production.
- Leaders should openly discuss safety with their workers.
- Acknowledging that eliminating accidents and incidents might be unachievable, instead, focusing on improving the safety climate reduces their occurrence and impact.
- Whilst dealing with accidents, incidents, and near misses, leaders should listen to their workers and focus on identifying the root causes instead of assigning blame or guilt.
- Process safety, integrated with effective personal safety management, ensures good safety performance of an organisation.
- Prioritise qualitative over quantitative measures when assessing safety performance, focusing on proactive and constant monitoring.
- Safety performance must not be incentivised, as it prevents open and honest reporting.
- The safety climate should be re-assessed every 18-24 months, ensuring that any of the recommendations implemented have the desired effect.

The author believes the recommendations are transferable across all sectors, especially those operating in a high-risk environment.

## Reflection

Completing the research project was the most challenging but rewarding journey the author has been on.

Completing the research survey proved to be more challenging than anticipated. At one point, the project was close to not being completed due to the difficulty in getting organisations to share their safety performance data for comparison. However, after an additional six months of effort, the data was finally obtained, and the project was completed.

## References


Adams, N. N. (2023). Four Distinct Cultures of Oilfield Masculinity, but Absent Hegemonic Masculinity: Some Multiple Masculinities Perspectives from a Remote UK Offshore Drilling Platform. *Journal of Contemporary Ethnography*, *52*(3), 344–378. https://doi.org/10.1177/08912416221116658 (last accessed 4th June 2023)

Ajslev, J., Dastjerdi, E. L., Dyreborg, J., Kines, P., Jeschke, K. C., Sundstrup, E., Jakobsen, M. D., Fallentin, N., & Andersen, L. L. (2017). Safety climate and accidents at work: Cross-sectional study among 15,000 workers of the general working population. Safety Science, 91, 320-325. https://doi.org/10.1016/j.ssci.2016.08.029 (last accessed 2nd March 2022 April 2023)

Alruqi, W. M., Hallowell, M. R., & Techera, U. (2018). Safety climate dimensions and their relationship to construction safety performance: A meta-analytic review. Safety Science, 109, 165-173. https://doi.org/10.1016/j.ssci.2018.05.019 (last accessed 14th February 2023)

Ashkanasy, N.M. and Dorris, A.B., (2018). Organizational culture and climate. The SAGE Handbook of Industrial, Work, and Organizational Psychology. Thousand Oaks, CA: Sage Publications, pp.187-205. (last accessed 4th April 2023)

Barbaranelli, C., Petitta, L., and Probst, T. M. (2015). Does safety climate predict safety performance in Italy and the USA? Cross-cultural validation of a theoretical model of safety climate. Accident Analysis & Prevention,Volume 77, Pages 35-44, ISSN 0001-4575, https://doi.org/10.1016/j.aap.2015.01.012(last accessed 4th June 2023)

Bensonch, C., Argyropoulos, C, D., Dimopoulos, C. V., Mikellidou, C, E. and Boustras, G. (2022). Analysis of safety climate factors and safety compliance relationships in the oil and gas industry, Safety Science, Volume 151, 105744, ISSN 0925-7535, https://doi.org/10.1016/j.ssci.2022.105744 (last accessed 3rd October 2023)

Beus, J. M., Payne, S. C., Bergman, M. E. & Arthur, W. (2010). Safety climate and injuries: An examination of theoretical and empirical relationships. Journal of Applied Psychology, 95(4), 713-727. (last accessed 4th May 2023)

Brown, R., & Holmes, H. (1986). The use of a factor-analytic procedure for assessing the validity of an employee safety climate model. *Accident Analysis & Prevention*, *18*(6), 455-470. https://doi.org/10.1016/0001-4575(86)90019-9

Christian, M.S. Bradley, J.C. Wallace, J.C. and Burke, M.J. (2009). Workplace safety: a meta-analysis of the roles of person and situation factors. Journal of applied psychology, 94(5), p.1103. (last accessed 2nd May 2022)

Clarke, S., (2006). The relationship between safety climate and safety performance: a meta-analytic review. *Journal of occupational health psychology*, *11*(4), p.315. (last accessed 16th November 2022)

Conchie, S. M., & Donald, I. J. (2008). The functions and development of safety-specific trust and distrust. *Safety Science*, *46*(1), 92-103. https://doi.org/10.1016/j.ssci.2007.03.004 (last accessed 4th April 2023)

Conrad F., Blair J. & Tracy E. (1999). Verbal reports are data! A theoretical approach to cognitive interviews. In Proceedings of the Federal Committee on Statistical Methodology Research Conference, Tuesday B Sessions, Arlington, VA, pp. 11–20. (last accessed 13 May 2023)

Cooper, G.L. Cartwright, S. and Earley P.C. (2001). The International Handbook of Organizational Culture and Climate. Wiley, New York. (last accessed 3 March 2023)

Cooper Ph.D., M. (2000). Towards a model of safety culture. Safety Science, 36(2), 111-136. https://doi.org/10.1016/S0925-7535(00)00035-7 (last accessed 4th April 2023)

Coyle, E.F., (1995). Integration of the physiological factors determining endurance performance ability. *Exercise and sport sciences reviews*, *23*, pp.25-63. (last accessed 3rd February 2023)

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. Psychometrika, 16, pages 297-334. (last accessed 14th April 2023)

Cullen (1990). The Public Inquiry into the Piper Alpha Disaster. Public Inquiry into the Piper Alpha Disaster Volume 1.pdf (epsc.be) (Last accessed 10th June 2023)

Dedobbeleer, N., & Béland, F. (1991). A safety climate measure for construction sites. *Journal of Safety Research*, *22*(2), 97-103. https://doi.org/10.1016/0022-4375(91)90017-P (last accessed 10th November 2023)

DeJoy, D. M., Schaffer, B. S., Wilson, M. G., Vandenberg, R. J., & Butts, M. M. (2004). Creating safer workplaces: Assessing the determinants and role of safety climate. Journal of Safety Research, 35(1), 81-90. https://doi.org/10.1016/j.jsr.2003.09.018 (last accessed 13th November 2023)

de Koster, R. B., Stam, D., & Balk, B. M. (2011). Accidents happen: The influence of safety-specific transformational leadership, safety consciousness, and hazard reducing systems on warehouse accidents. Journal of Operations Management, 29(7-8), 753-765. https://doi.org/10.1016/j.jom.2011.06.005 (last accessed 23rd December 2023)

Dillman, D. (2000). Mail and Internet Surveys: The Tailored Design Method, 2nd ed. Wiley, New York. (last accessed 4th February 2023)

Feng, Y., Teo, E. A. L., Ling, F. Y. Y., & Low, S. P. (2014). Exploring the interactive effects of safety investments, safety culture and project hazard on safety performance: An empirical analysis. *International Journal of Project Management*, *32*(6), 932-943. https://doi.org/10.1016/j.ijproman.2013.10.016 (last accessed 22nd May 2023)

Findley, M., Smith, S., Gorski, J., & O'neil, M. (2007). Safety climate differences among job positions in a nuclear decommissioning and demolition industry: Employees' self-reported safety attitudes and perceptions. *Safety Science*, *45*(8), 875-889. https://doi.org/10.1016/j.ssci.2006.08.027 (last accessed 4th April 2023)

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: Identifying the common features. Safety Science, 34(1-3), 177-192. https://doi.org/10.1016/S0925-7535(00)00012-6 (last accessed 14th April 2023)

Flin, R., Burns, C., Mearns, K., Yule, S. and Robertson, E.M., (2006). Measuring safety climate in health care. *BMJ Quality & Safety*, *15*(2), pp.109-115. (last accessed 14th April 2023)

George, D., and Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference. 11.0 update (4th ed.). Boston, MA: Allyn & Bacon. (last accessed 15th February 2023)

Gillen, M., Baltz, D., Gassel, M., Kirsch, L., & Vaccaro, D. (2002). Perceived safety climate, job demands, and coworker support among union and nonunion injured construction workers. Journal of Safety Research, 33(1), 33-51. https://doi.org/10.1016/S0022-4375(02)00002-6 (last accessed 5th June 2023)

Glendon, A., & Stanton, N. (2000). Perspectives on safety culture. *Safety Science*, *34*(1-3), 193-214. https://doi.org/10.1016/S0925-7535(00)00013-8 (last accessed 7th June 2023)

Glendon, A., & Litherland, D. (2001). Safety climate factors, group differences and safety behaviour in road construction. Safety Science, 39(3), 157-188. https://doi.org/10.1016/S0925-7535(01)00006-6(last accessed 10th December 2023)

Hale, A.R. (2000). Culture's confusions - Safety Science, 34, pp. 1-14(last accessed 28th April 2023)

Hudson, P., (2012). Why is achieving zero accidents so difficult? In: Proceedings of the 11th SPE/APPEA International Conference on Health, Safety, and Environment in Oil and Gas Exploration and Production, Perth, Australia, p. 11–12 September 2012. (last accessed 25th May 2023)

Hofmann, D.A. and Stetzer, A., (1998). The role of safety climate and communication in accident interpretation: Implications for learning from negative events. Academy of management journal, 41(6), pp.644-657. (last accessed 8th October 2022)

Hofmann, D.A.  Morgeson F.P. (2004). The role of leadership in safety. The Psychology of Workplace Safety, American Psychological Association, Washington, DC, US pp. 159-180 (last accessed 1st May 2023)

Holmstrom (2005). U.S. Chemical Safety And Hazard Investigation Board Investigation Report Statement of CSB Lead Investigator Don Holmstrom Updating the Status of the Board's BP Texas City Refinery Investigation. APPENDIX Q: Prior Incidents page 306 (last accessed 4th April 2023)

Hopkins, A. (2000). Lessons from Longford, The Esso Gas Plant Explosion CCH Australia Ltd https://www.researchgate.net/publication/311427758_Lessons_from_Longford_The_Esso_Gas_Plant_Explosion (last accessed 8th October 2023)

Hopkins, A., (2008). Failure to Learn, The BP Texas City Refinery Disaster, CCH, Sydney (last accessed 28th June 2023).

Hopkins, A . (2008). Studying Organisational Cultures and their effects on Safety. Studying organisational cultures and their effects on safety. (apa.org) (last accessed 26th October 2022).

Hopkins, A., (2009). Thinking about process safety indicators. Thinking About Process Safety Indicators (anu.edu.au) (last accessed 15th March 2023).

House, R.J. Hanges, P.J. Javidan, M. Dorfman, P.W. and Gupta V. (2004).Leadership, Culture, and Organizations: The GLOBE Study of 62 Societies. Thousand Oaks, Calif.: Sage Publications. (last accessed 23rd December 2023

Huang, Y., Lee, J., McFadden, A. C., Rineer, J., & Robertson, M. M. (2017). Individual employee's perceptions of "Group-level Safety Climate" (supervisor referenced) versus " Organization-level Safety Climate" (top management referenced): Associations with safety outcomes for lone workers. Accident Analysis & Prevention, 98, 37-45. https://doi.org/10.1016/j.aap.2016.09.016 (last accessed 1st May 2023)

Johnson, S. E. (2007). The predictive validity of safety climate. Journal of Safety Research, 38(5), 511-521. https://doi.org/10.1016/j.jsr.2007.07.001 (last accessed 28th November 2023)

Kalteh, O,H. Mortazavi,S, B. Mohammadi, E and Salesi, M. (2019). The relationship between safety culture and safety climate and safety performance: a systematic review. Pages 206-216  Available here: https://doi.org/10.1080/10803548.2018.1556976 (last accessed 5th June 2023)

Kines, P., Lappalainen, J., Mikkelsen, K. L., Olsen, E., Pousette, A., Tharaldsen, J., Tómasson, K., and Törner, M. (2011). Nordic Safety Climate Questionnaire (NOSACQ-50): A new tool for diagnosing occupational safety climate. International Journal of Industrial Ergonomics, 41(6), 634-646. https://doi.org/10.1016/j.ergon.2011.08.004 (last accessed 9th November 2023)

Kjellén, U., (2000). *Prevention of accidents through experience feedback*. CRC Press. (last accessed 9th June 2023)

Lee, J., Sylvara, A., Choi, J., and Lee, S. (2023). On different pages? More dangerous than a papercut: Implications of incongruence between leader and member safety climate perceptions. Safety Science, 163, 106111. https://doi.org/10.1016/j.ssci.2023.106111 (last accessed 22nd November 2022)

Leclercq, S., Morel, G., & Chauvin, C. (2018). Process versus personal accidents within sociotechnical systems: Loss of control of process versus personal energy? *Safety Science*, *102*, 60-67. https://doi.org/10.1016/j.ssci.2017.10.003

Likert, R. (1932). A technique for the measurement of attitudes. Woodsworth R.S., Archives of Psychology, vol. 140, Columbia University, New York (last accessed 13th Febuary 2023)

Liu, X., Huang, G., Huang, H., Wang, S., Xiao, Y., & Chen, W. (2015). Safety climate, safety behavior, and worker injuries in the Chinese manufacturing industry. *Safety Science*, *78*, 173-178. https://doi.org/10.1016/j.ssci.2015.04.023 (last accessed 1st May 2023)

Luria, G. (2010). The social aspects of safety management: Trust and safety climate, Accident Analysis & Prevention, Volume 42, Issue 4, Pages 1288-1295, ISSN 0001-4575, https://doi.org/10.1016/j.aap.2010.02.006. (last accessed 25th November 2023)

Mataqi I.Y. and Srikanth Adivi B.S., (2013). Process safety vs personal safety: Can't we get along with one? ASSE Professional Development Conference and Exposition, Session No. 758. (last accessed 1st May 2023)

Mearns, K., Flin, R., Gordon, R., & Fleming, M. (1998). Measuring safety climate on offshore installations. Work & Stress, 12(3), 238–254. (last accessed 27th August 2022)

Milijic, N., Mihajlovic, I., Strbac, N. and Zivkovic, Z., (2013). Developing a questionnaire for measuring safety climate in the workplace in Serbia. International journal of occupational safety and ergonomics, 19(4), pp.631-645. (last accessed 31st July 2022)

Morgan, G. and Smircich, L., (1980). The case for qualitative research. *Academy of management review*, *5*(4), pp.491-500. (last accessed 28th November 2022)

Mosley, H., & Mayer, A. (1999). Benchmarking national labour market performance: a radar chart approach. https://nbn-resolving.org/urn:nbn:de:0168-ssoar-128578 (last accessed 3rd January 2023)

Nahrgang, J.D., Morgeson, F.P., Hofmann, D.A., (2008). Predicting safety performance: a meta-analysis of safety and organisational constructs. In: Presented at the Annual Meeting of the Society for Industrial and Organizational Psychology, San Francisco, (last accessed 25th November 2023)

Noor Arzahan, I. S., Ismail, Z., & Yasin, S. M. (2022). Safety culture, safety climate, and safety performance in healthcare facilities: A systematic review. Safety Science, 147, 105624. https://doi.org/10.1016/j.ssci.2021.105624 (last accessed 11th April 2023)

Parker, S.K., Williams, H.M. and Turner, N., (2006) Modeling the antecedents of proactive behavior at work. *Journal of applied psychology*, *91*(3), p.636. (last accessed 28th September 2022)

Probst, T.M. and Brubaker, T.L. (2001). The effects of job insecurity on employee safety outcomes: cross-sectional and longitudinal explorations. J. Occup. Health Psychol., 6 (2) (2001), pp. 139-159 (last accessed 30th September 2022)

Reason, J. (1997). Managing the Risks of Organisational Accidents. Ashgate, Aldershot, UK (last accessed 18th April 2023)

Reason, J., (2000). Safety paradoxes and safety culture. *Injury Control and Safety Promotion*, *7*(1), pp.3-14. https://doi.org/10.1076/1566-0974(200003)7:1;1-V;FT003 (last accessed 11th June 2023)

Reiman, T., & Pietikäinen, E. (2012). Leading indicators of system safety – Monitoring and driving the organizational safety potential. *Safety Science*, *50*(10), 1993-2000. https://doi.org/10.1016/j.ssci.2011.07.015 (last accessed 31st October 2022)

Reiman, T., Pietikäinen, E. and Oedewald, P., (2010). Multilayered approach to patient safety culture. *Quality and Safety in Health Care*, *19*(5), pp.e20-e20. (last accessed 3rd March 2023)

Ropeik, D., (2002). Understanding factors of risk perception. Nieman Reports, 56(4), p.52. (last accessed 24th November 2023)

Saari, J. (1990). On strategies and methods in company safety work: From informational to motivational strategies. *Journal of Occupational Accidents*, *12*(1-3), 107-117. https://doi.org/10.1016/0376-6349(90)90081-6 (last accessed 1st April 2023)

Sandnes, F.E., Flønes, A., Kao, WT., Harrington, P., and Issa, M. (2020). Searching for Extreme Portions in Distributions: A Comparison of Pie and Bar Charts. In: Luo, Y. (eds) Cooperative Design, Visualization, and Engineering. CDVE 2020. Lecture Notes in Computer Science(), vol 12341. Springer, Cham. https://doi.org/10.1007/978-3-030-60816-3_37 (last accessed 9th May 2023)

Salminen, S., Saari, J., Saarela, K. L., and Räsänen, T. (1993). Organisational factors influencing serious occupational accidents. Scandinavian Journal of Work, Environment and Health, 352-357. (last accessed 1st April 2023)

Saunders, M., Lewis, P.H.I.L.I.P. and Thornhill, A.D.R.I.A.N., (2007). Research methods. *Business Students 4th edition Pearson Education Limited, England*, *6*(3), pp.1-268. (last accessed 23rd June 2022)

Schneider, B., Ehrhart, M. G. and Macey, W. H. (2013). 'Organizational Climate and Culture, *Annual Review of Psychology'*, 64(1), pp. 361–388. Available from: https://www.annualreviews.org/doi/10.1146/annurev-psych-113011-143809 (last accessed 11th April 2023)

Seo, D., Torabi, M. R., Blair, E. H., & Ellis, N. T. (2004). A cross-validation of safety climate scale using confirmatory factor analytic approach. *Journal of Safety Research*, *35*(4), 427-445. https://doi.org/10.1016/j.jsr.2004.04.006 (last accessed 21st February 2023)

Sexton, J.B., Thomas, E.J. and Helmreich, R.L., (2000). Error, stress, and teamwork in medicine and aviation: cross-sectional surveys. Bmj, 320(7237), pp.745-749 (last accessed 23rd December 2022)

Shabanov, Y., & Shetreet, E. (2022). The scalar interpretation of double negation. *Journal of Pragmatics*, *189*, 55-65. https://doi.org/10.1016/j.pragma.2021.12.013 (last accessed 03rd June 2023)

Shannon, M. C. (1997). Adaptation of Plants to Salinity. *Advances in Agronomy*, *60*, 75-120. https://doi.org/10.1016/S0065-2113(08)60601-X (last accessed 3rd June 2023)

Sinclair, R. R., Martin, J. E., & Sears, L. E. (2010). Labor unions and safety climate: Perceived union safety values and retail employee safety outcomes. *Accident Analysis & Prevention*, *42*(5), 1477-1487. https://doi.org/10.1016/j.aap.2009.11.003 (last accessed 13th April 2023)

Sjöberg, L., (2000). The methodology of risk perception research. *Quality and Quantity*, *34*, pp.407-418. (last accessed 27th April 2023)

Smith, G. S., Huang, Y., Ho, M., & Chen, P. Y. (2006). The relationship between safety climate and injury rates across industries: The need to adjust for injury hazards. *Accident Analysis & Prevention*, *38*(3), 556-562. https://doi.org/10.1016/j.aap.2005.11.013 (last accessed 23rd November 2022)

Sneddon, A., Mearns, K., & Flin, R. (2013). Stress, fatigue, situation awareness and safety in offshore drilling crews. *Safety Science*, *56*, 80-88. https://doi.org/10.1016/j.ssci.2012.05.027

Sonderen, E.V., Sanderman, R. and Coyne, J.C., (2013). Ineffectiveness of reverse wording of questionnaire items: Let's learn from cows in the rain. PloS one, 8(7), p.e68967. (last accessed 1st May 2023)

Teo, A.L., Feng, Y. (2010). The moderated effect of safety investment on safety performance for building projects. The International Journal of Construction Management, 10 (3), pp. 45-61 (last accessed 5th November 2022)

Törner, M., & Pousette, A. (2009). Safety in construction – a comprehensive description of the characteristics of high safety standards in construction work, from the combined perspective of supervisors and experienced workers. *Journal of Safety Research*, *40*(6), 399-409. https://doi.org/10.1016/j.jsr.2009.09.005 (last accessed 14th April 2023)

Vu, T. and De Cieri, H. (2014). 'Safety culture and safety climate definitions suitable for a regulator: A systematic literature review', Research report 0414-060-R2C. Monash University. (last accessed 11th November 2022)

Wanous, J. P., Reichers, A. E., and Hudy, M. J. (1997). Overall Job Satisfaction: How Good Are Single-Item Measures? Journal of Applied Psychology, 82, 247-252 http://dx.doi.org/10.1037/0021-9010.82.2.247 (last accessed 11th April 2023)

Wiegman et al. (2002). A review of safety culture theory and its potential application to traffic safety. https://www.researchgate.net/publication/242695085_A_review_of_safety_culture_theory_and_its_potential_application_to_traffic_safety (last accessed 12th April 2023)

Yule, S. (2003). Senior Management Influence on safety performance in the UK and US energy sectors. Doctoral thesis, University of Aberdeen, Scotland. (last accessed 11th November 202)

Zohar, D. (1980). Safety climate in industrial organisations: theoretical and applied implications Journal of Applied Psychology, 65 (1), pp. 96-102 (last accessed 27th April 2023)

Zohar, D.  (2010). Thirty years of safety climate research: reflections and future directions. Accident Analysis & Prevention, 42 (5) (2010), pp. 1517-1522 https://doi.org/10.1016/j.aap.2016.09.016 (last accessed 25th January 2023)

Zohar, D. and Luria, G., (2005). A multilevel model of safety climate: cross-level relationships between organization and group-level climates. *Journal of applied psychology*, *90*(4), p.616. A Multilevel Model of Safety Climate: Cross-Level Relationships Between Organization and Group-Level Climates. (apa.org) (last accessed 1st May 2023)

Zohar, D. and Polachek, T., (2014). Discourse-based intervention for modifying supervisory communication as leverage for safety climate and performance improvement: a randomized field study. *Journal of applied psychology*, *99*(1), p.113. (last accessed 10th June 2023)

**Bibliography**

ACSNI, (1993). Case Study Safety culture at a large distribution centre. ACSNI study group on human factors. Third report Organising for Safety. 1993. HSE Books. (last accessed 1st April 2022)

Des Plaines Vol. 41, Iss. 10, Oct (1996): 28-33. Available here; The trust factor in safety performance - ProQuest (last accessed 1st May 2023)

Frederick, J.K (2021) When to Ask (or Not Ask) Demographic Questions ITHAKA S+R Demographics (last accessed 7th April 2023)

Harvard Mental Health Letter, "The psychology of risk perception." (2011). Gale Academic OneFile. Link.gale.com/apps/doc/A258102802/AONE?u=ustrath&sid=bookmark-AONE&xid=d09508da. (last accessed 1st June 2022)

HSE - Measuring the Safety Climate in Organisations - Reduce injuries and costs through cultural change (2001). Available here: https://books.hse.gov.uk/gempdf/Measuring_the_Safety_Climate_in_Organisations.pdf (last accessed 4th June 2023)

HSE (2000) OFFSHORE TECHNOLOGY REPORT 2000/049 Safety culture maturity model https://www.hse.gov.uk/research/otopdf/2000/oto00049.pdf (last accessed 12th June2023)
HSE Managing for health and safety (hse.gov.uk) (last accessed 2nd October 2022)

HSE. Measuring The Safety Climate in Organisations Reduce injuries and costs through cultural change. Available here;

HSG65 Managing for Health and Safety. Available here; https://books.hse.gov.uk/gempdf/Measuring_the_Safety_Climate_in_Organisations.pdf (last accessed 1st June 2023)

In road construction. Safety Science, 39(3), 157-188. Injuries in work groups. Journal of organisational behaviour, 23(1), 75-92 (last accessed 10th November 2023)

Italy and the USA? Cross-cultural validation of a theoretical model of safety climate. Accident analysis and prevention, 77, 35-44.(3rd June 2023)

Oah, S., Na, R., & Moon, K. (2018). The Influence of Safety Climate, Safety Leadership, Workload, and Accident Experiences on Risk Perception: A Study of Korean Manufacturing Workers. *Safety and Health at Work*, *9*(4), 427-433. https://doi.org/10.1016/j.shaw.2018.01.008 (last accessed 4th June 2023)

Oil and Gas UK – Accident Statistics for Offshore Units on the UKCS 1990 – 2007 https://oeuk.org.uk/wp-content/uploads/2020/09/HS029-2009-CURRENT-Accident-Statistics-1.pdf (last accessed 22nd April 2022)

RIDDOR 2012 Available here: RIDDOR ; accessed (last accessed 7th June 2023

Rozendal, S. and Hale, A.R. (2000). January. Analysis of HSE-performance indicators. IADC/SPE Drilling Conference, Society of Petroleum Engineers (last accessed 3rd February 2023)

Shell (2023) Goal Zero available here: Shell, 2023 https://www.shell.com/sustainability/safety/our-approach.html(last accessed 6th June 2023)

The trust factor in safety performance. Simon, Rosa-Antonia
Total Energies (2023) Zero Fatalities: Total Energies; (last accessed 6th June 2023