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MASTER'S THESIS

Organizational safety culture, a comparison between Norwegian maritime transport industry and maintenance shipyards.

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List of Abbreviations

SCs	Supply Chains
IMO	International Maritime Organization
OECD	Organization for Economic Co-operation and Development
LNG	Liquified Natural Gas
LPG	Liquified Petroleum Gas
ROPAX	Roll-On/Roll-Off Passenger
GNP	Gross National Product
UVR	Ultraviolet radiation
SMS	SMS safety management systems
ISM	ISM International Safety Management

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Abstract

Numerous studies have been conducted into the safety of different maritime transportation systems, but no prior study on the safety culture and safe workplace practices in the ship repair and maintenance industry with special focus on offshore oil storage and processing units. This research aims to examine the safety culture and behavior in the Norwegian maritime maintenance industry by investigating the safety management and practices for the offshore oil storage and processing unit.

Four databases- namely Oria, Google Scholar, Science Direct and Web of Science were used to search for the relevant materials for the studies. Keywords were combined to generate a Boolean string which was tested until it produced a search string that detected all key articles. **S**tudies were selected to be included in the research work if they were published in the last 10 years (2012-2022) in a peer-reviewed journal if the published work is written in English and the full text is available when the article focused on the safety culture, the human factor and if they were not duplicated.

The organizational safety culture, demanding working conditions, safety outcomes, and sector focus on safety regarding the safety culture and behaviour gathered from personnel working in the maritime maintenance and repair industry were extensively examined.

The mean safety culture obtained in this study was 64.87 which shows that the Norwegian maintenance shipyard had a much higher safety culture index. However, two key issues that might further improve the safety culture in the Norwegian maintenance shipyard, include the adherence to safety guidelines and risk perception.

Keywords: Safety culture, occupational, maintenance shipyard, maintenance culture, maritime maintenance, safety behavior, offshore oil storage tanker vessel.

Acknowledgement

I wish to acknowledge my father for his support during all my studies. It would never happen without his kind support.

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Chasan Dikme

1 Introduction

This chapter attempts to expose the reader to the basic requirements of occupational safety culture in Norwegian ship repair and maintenance shipyards and Norwegian maritime Industry. Standard safety requirements by Norwegian petroleum safety authority. Furthermore, offshore vessel under repair and maintenance (Njord Bravo) and scope of services for Multi Vedlikehold AS.

1.1 Norwegian ship repair and maintenance shipyards

The periodic substitution of building new ships with repairing or maintaining the old ships tailored the activities in the shipyard in line with the business cycle. Additional or replacement of vessels are provided by shipbuilding, and it was the first in the industry to encounter overcapacity in the fleet. However, ship repair and maintenance, in contrast to shipbuilding benefitted the entire sailing fleet. Maintenance demand was more predictable and stable over time. Although building and maintenance enhance or complete each other over time, these two combined faced a challenge at the business level as they specialized. Over time, tension build-up combining shipbuilding and maintenance was conveyed by John Kleven, a manager of a shipyard, North-West region, Norway. He said the old customers knew the majority of the workers and they move to bring the preferred worker to build new ships alongside repairing their ships at the individual workshop, not the shipyard. However, the activities were not rational since the safety culture might not be followed properly and the profits were marginal. Hence, there is a need to choose either a shipbuilding or repairing job, and shipbuilding was chosen. After 1960, shipbuilding became the primary activity in the shipyard in Norway specifically, in North-West (Karlsen, 2005) and the trade surplus was heavily invested in modernizing shipbuilding. Such techniques necessitated capital build-up because maintenance did not generate enough revenues, and the business's return was limited. The primary activity

was the construction of deep-sea fishing vessels for regional and Icelandic fleets (Gulowsen 1995).

Though, if new ships are built in some period, there is a need to maintain the tools, capacity, and equipment to serve the regional fleets in the situation of breakdown or repair as reported by Karlsen, (2005). The repair jobs were the most profitable and safest, but only to a certain extent. Further, the Norwegian shipyards felt obligated to meet and serve the needs of the regional fleet as this provided employment opportunities. After a generation of dedicated shipyard maintenance, building ships became a half-hearted attempt (Gulowsen 1995).

1.2 Norwegian maritime Industry (transport and cargo)

Norway, one of the largest nations in world's maritime offshore, with more than 150 years of experience in shipping and shipbuilding (Tenold, 2019). Despite having a population of only 5.3 million people, Norway is regarded as a maritime giant, commanding the world's fifth-biggest commercial fleet in terms of value. The Norwegian coastline stretches for nearly 20,000 kilometers. The length of the Norwegian coastline, including fjords and islands, is 126 percent that of the United States (Ferrante et al., 2019). In 2019, 1,787 foreign-going ships were controlled and registered by Norwegian (Murphy, 2021). Offshore service/specialty boats, gas (LNG/LPG) tankers, oil tankers, bulk carriers, vehicle carriers, chemical tankers, and cruise operations are all areas where Norwegian shipowners are involved (Bjerkan et al., 2021). Many have referred to Norway's maritime sector as the world's most globally competitive and knowledge-based industry. Cargo and border crossing passenger transport are the two primary categories of maritime transport in Norway, both of which operate under separate framework conditions (Nvestad et al., 2018). Cargo transport is also known as coasters, and it is divided into two categories: general cargo, includes neo bulk, break bulk, and containerized cargo, while bulk freight, includes dry bulk cargo and liquid bulk (Zhao et al., 2020).

The number of maritime transportation incidents has substantially decreased during the previous decade (Dominguez-Péry et al., 2021). However, the grow in the size of transportation vessels, a single occurrence, like oil spills from "mega" tankers, might leads to catastrophic and long-term effects on maritime environment, its ecosystems and the local economy (Carpenter, 2019). Accidents in Maritime transport sector are complicated, and they are produced by a variety of events that can result in the loss of human, goods and maritime life, as well as irreparable ecological, environmental, and economic harm. Numerous studies have identified various human error (direct or indirect) as a major source of maritime accidents, raising many unsolved concerns regarding the best method to avoid catastrophic human error in maritime situations (Zhang et al., 2020; Youn et al., 2019; Dominguez-Péry et al., 2021). According to the European Maritime Casualty Information Platform (Nvestad et al., 2018), 935 injuries and 100 fatalities on an average occur every year between 2011 and 2016. Between 2004 and 2013, there were 15 fatalities and 424 injuries each year aboard Norwegian ships (NOR and NIS) (Nvestad et al., 2015).

1.3 Maritime safety requirements (transport and shipyards)

The International Maritime Organization's (IMO) SMS mandate in the International Safety Management (ISM) regulation has prompted a focus on organizational safety culture in the maritime industry. The ISM code's principal purpose was to instill gradually an innovative safety culture in the maritime sector, according to the IMO. Nvestad et al. (2020) describe safety culture in the organizational as “safety-related characteristics of culture in organizations”. According to Noort et al. (2016), there are two types of organizational safety management (OSM). The formal side of safety ("how things should be done") is the first, which is enshrined in processes, organizational charts, routines, and other documents while the second is an aspect that is informal (“how things are actually done”). As a result, it's possible to claim

that the ISM-SMS code's standards correspond to the formal part of OSM, whilst practical SMS enactment and implementation refer to the safety culture or informal aspect. However, several studies have emphasized on the relevance of safety culture in the maritime sector, there appear to be fewer studies on maritime safety culture than in other industries. Mallam et al. (2019) conducted literature searches and discovered that only a few research on safety climate and culture had been conducted recently in the shipping industry.

Previous research suggests that safety culture is relevant at all levels, not only the organizational level; it also suggests that safety culture is significant at the national level (Schwartz et al., 2019). When it comes to safety performance and culture, research demonstrates significant variances within sectors and subsectors (Stemn et al., 2019; Mohammadi et al., 2018; Nvestad et al., 2020). Thus, to completely comprehend the impact of safety culture on maritime transport safety, one must examine safety culture in organizations, in addition with the social units such as nations, regions, and sectors. Because safety culture is contagious, it is often linked to social groups. Safety culture, according to Nvestad et al. (2020), is defined as "safety-relevant modes of thinking or doing that are (re)created via the cooperative negotiation of individuals in social circumstances". This term may be used for several levels of analysis, such as organizational, sectoral, and national.

According to research, the likelihood of occupational injuries varies depending on the nautical subsectors. According to Shan and Lippel (2019), passenger ships have a lower probability of major fatal accidents and occupational injuries than coastal cargo ships, indicating that the former is safer. Passenger vessel workers, on the other hand, had a greater risk of all occupational accidents than coaster personnel, according to this study. This paradox, according to the authors, might be due to little or less information and lower organizational safety culture in the coaster vessels when compare with passenger ships. In a study conducted by Nvestad et al. (2020), the safety culture and working circumstances in Norwegian maritime cargo transport

and maritime passenger was examined considering the sectors' framework conditions like the economy, market, and Policies. In addition, the study looked at the link between human behaviour and safety culture. The findings stated that the coastal freight sector, poorer safety culture ratings are linked to greater levels of dangerous behaviour, which might be due to framework circumstances. Finally, Bye and Almklov (2019) showed that greater risk occurs in the coastal freight vessels while vessels associated with transporting petroleum product had the minimum.

In Norwegian coastal freight transport, Strkersen and Thorvaldsen (2021) emphasize the relevance of circumstances framework and working conditions for risky behaviours. The relevance of goal struggles between production onboard and safety is highlighted in this study. Although, the number of the respondents are few, but the authors discovered that to get the work done, one-third of respondents put themselves at risk, and roughly forty percent break processes to get the task done, particularly due to proficiency expectations. This suggests that job pressure has an impact on safety behaviour.

According to Bye and Almklov (2019), the following factors are linked to the probability of occupational accidents:

i. Younger maritime workers were at a higher risk than older maritime workers.

ii. The initial period onboard a ship and the change of ship were recognized as risk factors.

iii. Foreigners are much less likely to be involved in an accident than locals.

iv. The most significant mishaps occurred on the deck.

Demir et al. (2021) discovered the following elements to be connected to personal accident participation in research on evaluating the factors that impact the self-reported quality of life among maritime workers:

i. The average age of a maritime worker is 35 years.

ii. Tour duration (117 days)

iii. Placement (had high risk of occupational accident)

iv. Working in the engine room

Several studies have discovered that nationality has an impact on the likelihood of an occupational accident. dám et al. (2014) discovered that 17.5% of accident rate per 100,00 person-days is recorded among the Western European maritime workers only which was substantially greater when compare with the Indian, Eastern European, and South-East Asian maritime workers in a study conducted on the occupational accidents in the Danish merchant fleet. The discrepancies appear to be persistent across severity levels, suggesting that the results aren't (only) due to varied reporting rates. Based on Norwegian data, Bye and Almklov (2019) indicate comparable tendencies.

Workplace Safety:

Workplace safety denotes the safety rules in a working location at a company and it includes all factors that affect employees' health, safety, and it's well-being. Drug and alcohol addiction, dangerous working conditions or processes, Environmental dangers, and workplace violence are all examples of workplace safety.

Organizational safety culture:

Workgroup safety and Individual attitudes, perceptions, behaviour, values, and beliefs, that reflect the commitment of an organization to safety and possible ways on how to address safety and health concerns are referred to as organizational safety culture. Workers' attitudes, behaviours, beliefs, values, and perceptions about how safety is managed at work make up a safety culture.

Demanding working conditions:

Fatigue and poor sleep quality have been associated with a greater proportion of reported injuries, mistakes, and risky behaviors. Some jobs are emotionally and physically taxing, and

often require shift work, which causes people to get exhausted. The mental and social dangers are grouped together as psychosocial threats. When time and a job load have become progressively ubiquitous over the preceding decade, mental hazards have arisen (Eyayo, 2014). Dreary job, work that demands constant focus, inconsistent working hours, mobile labour, work done in a hostile environment (for example, police or jail employment), constrained work, or excessive responsibility in terms of human or monetary considerations can all have negative mental effects (Liu et al., 2020). Rest aggravations, wear out diseases, and wretchedness have all been linked to mental pressure and overburdening.

Advancement of open and good connections in the work environment, support of the person's job and personality at work, and consolation of collaboration are the most common measures for strengthening the social aspects of work. The following are examples of organizational psychosocial factors (Eyayo, 2014):

1. Aggression and violence
2. Working alone
3. Night and shift work
4. Long hours of labour
5. Changes in time zones

Safety behavior (unsafe behavior):

There are many different interpretations of safety behavior; however, leading indicators rather than lagging indicators focus on vulnerable behaviors that may lead to minor or serious injury, or the behaviors that may contribute to injury prevention. Also, safety behavior might be the behaviors that influence a culture change through attitudes and perceptions, and behaviors that influence a culture change through attitudes and perceptions.

Personal injuries

1. **Work Accidents:**

This is defined as an "unexpected incident that causes personal injury or property damage. According to Herbert William Henrich, known as the workplace safety movement founding father, defined the workplace accident as the unplanned and uncontrolled incidents that result in human injury. Workplace accidents may be traumatic and costly for both companies and employees, depending on whose definition you prefer. " Workplace accidents,

2. Maritime Accidents:

Working in the maritime business is both fascinating and rewarding, but it is also quite dangerous. Accidents resulting in injuries, and even fatalities, are not commonplace among those who operate in this field. Whether working as a longshoreman at a port, as a seaman on a ship, on an offshore platform, or in another maritime position, the work is frequently physically demanding, involves long hours, and has the danger of being involved in an accident.

The comparison between Norwegian maintenance shipyard and Norwegian maritime industry were chosen due to an intriguing paradox: recent incidents shows that maritime industry workers had a greater occupational risk compare with workers in maintenance shipyards, but lower risk of fatal accidents (Kobka and Sabadash, 2018). The lower probability of all occupational accidents among maintenance shipyards is thought to be due to improper documentations and weaker organizational safety culture compared to maritime industry (Shan and Lippel, 2019).

This thesis aims to examine the organizational safety culture, the working conditions in the Norwegian maritime industry. Also, the study explores the safety outcomes (safety behaviors and crew member accidents) and the effect of the framework conditions on the safety culture and the working conditions.

1.4 Njord Bravo – offshore oil storage tanker vessel

Njord Bravo is an offshore oil storage tanker vessel. I was built in 1997 at Turku, Finland. This vessel was operational in Norwegian sea from 1998 to 2016. In 2018 it came to Aibel shipyard, Haugesund for repair and maintenance work.

Table 1: Njord Bravo vessel details

Description	Details/units
IMO number	8766181
Year of Construction	1997
Gross Tonnage (GRT)	60750
Summer dead weight	95000 t
Length x Width	233 m × 42 m

According to **Table 1**, 8766181 is the International Maritime Organization (IMO) number for Njord Bravo offshore oil storage tanker vessel. The vessel length is 233 meters, and it has an oil storage capacity of 110,000 cubic meters of crude oil. The vessel has dead weight of 95,000 ton and 60750 cubic metres of volume.

Njord Bravo - offshore oil storage tanker vessel was deployed together with Njord Alpha offshore oil platform at Njord oilfield in the North Sea.

Both oil and gas are extracted from the Njord offshore platform. The gas is transported through a pipeline connected by Åsgard gas pipeline. The oil extracted at Njord platform is stored in Njord Bravo offshore storage vessel and transported to the onshore processing facility/oil refinery. An overview of Njord Bravo in the North Sea is shown in Figure 1.

Figure 1: Njord Bravo – offshore oil storage tanker vessel

1.5 Aibel – ship repair and maintenance shipyard

Aibel is the main contractor of the repair and maintenance services for the Njord Bravo – offshore oil storage tanker vessel. In this project, Multi Vedlikehold AS is working as sub-contractor for Aibel shipyard which is located in the city of Haugesund in Rogaland province in Norway.

1.6 Service providing company (Multi vedlikehold AS)

Multi Vedlikehold AS is an ISO company. ISO refers to

- isolering
- overflatebehandling
- stillas

which in English refers to isolation, surface treatment and scaffolding. Isolation services refers to the repair and maintenance of insulation installed in the various parts of the offshore oil storage tanker vessel. For example, isolation between cargo tanks and accommodation section, parts of engine and STL (submerged turret loading) system. Surface treatment refers to the corrosion prevention and industrial coating services provided by the company. It also includes

sandblasting and industrial coating of the steel or various metals. Scaffolding is mandatory part of ship repair and maintenance industry as it provides access to do any job in limited access areas such as cargo tanks, water ballast tanks, working at height.

1.7 Structure of the thesis

The approach of the literature review is provided in Chapter 2 after the introductory chapter. The research design is described in great depth to ensure that the reader understands the decisions taken in this work. Chapter 3 contains the findings of the quality appraisal and risk of bias evaluation of the studies analyzed in this thesis, as well as a summary of the main data retrieved from them. The results of the qualitative analysis among crew members on the comparison of the occupational safety conditions of maritime maintenance shipyard are reported in the subsequent sections of Chapter 3. Before the thesis is finished in chapter 5, the results, consequences for practice and theory, and constraints are examined in chapter 4.

1.8 Limitations

The restrictions resulting from the preceding characterization of the research field are as follows:

i. The pool of potential literature for the review is restricted to works published in peer-reviewed journals, excluding other potential sources of information (i.e., industry white papers and conference proceedings).

ii. Samples and selection issues.

iii. For statistical measures, the sample size is insufficient.

iv. There aren't any previous research studies on the subject.

v. Data access is restricted.

2 Literature review

A systematic review used in this research work uses formulated question that employs both explicit and systematic methods to recognise, hand-picked, and critically evaluate relevant research, as well as collect and analyse data from the previous studies (Martinic et al., 2019). The thesis was designed using the Systematic reviews (Preferred Reporting Items) and Meta-Analyses (PRISMA) statement which was published in 2009. The systematic reviews is designed to assist in the transparent report which contain why the review was done, what the authors did, and what they found (Page et al., 2021). As indicated by the PRISMA statement, a review protocol should be included in the methodology, hence, this study began with the creation of such a protocol using a template provided by previous researchers (Wang et al., 2019). The protocol specifies the systematic review's primary objectives, methods, and outcomes, and can thus be used to encourage transparency and serving as a road map for the review.

The literature review process used in this thesis to establish a clear structure is shown in Figure 2.

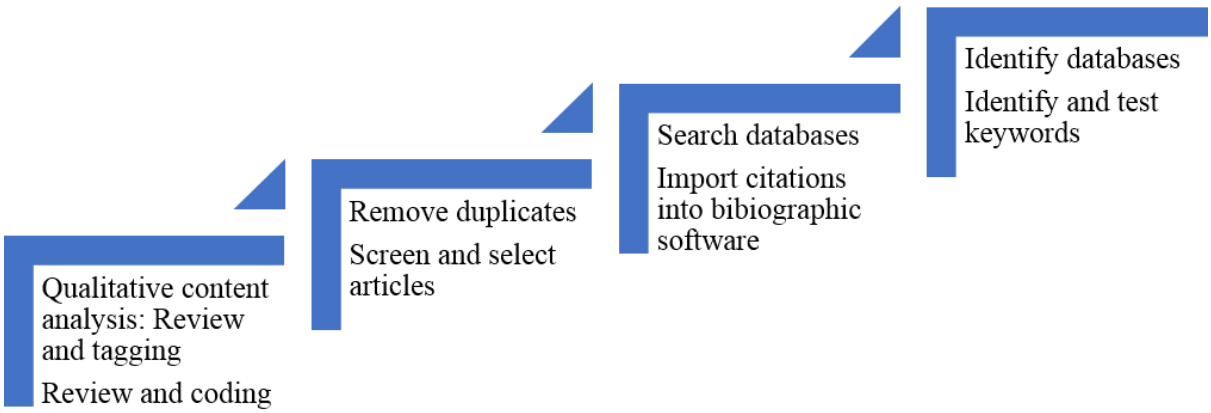

Figure 2: The literature review stages

2.1 Search Strategy

As shown in **Figure 2**, the study's search strategy shows the approach to both the pre-search and actual search stages of the literature review process. The list of relevant databases for maritime studies created by the library of Western Norway University of Applied Sciences was used to select and determine the databases that would be used for searching the literature. Databases that could identify relevant peer-reviewed publications were checked through the list. As a result, the following databases were chosen to conduct the search:

i. Science Direct
ii. Oria
iii. Web of Science
iv. Google Scholar

The search string was constructed after deciding which databases to search for literature. The objective was to create a search phrase that was specific enough to lower the overall number of articles identified while still guaranteeing that no essential material was missed. To accomplish so, a number of articles discovered during the first keyword testing were recognized as key articles that had to be replicated by the final search string. Keywords were combined to generate a Boolean search string, which was tested until it produced a search string that detected all key articles while filtering out as many uninteresting items as feasible. The indicated preliminary search string resulted in the discovery and elimination of overlapping search words. As a consequence, the search string provided in **Table 2** below discovered all designated important articles while excluding as many articles as feasible that were unrelated to the study issue.

Table 2: Search strings and results in four databases

Database	Search string	Results
Oria	(Safety culture OR maritime safety OR Safety behaviours OR Safety OR culture) AND (maintenance OR repair OR overhaul OR) AND (Ship OR vessel OR cargo OR maritime transport OR tanker OR Offshore oil storage tanker vessel) AND (Maritime OR marine OR sea OR ocean) AND (shipyard OR ship OR dry dock) AND (Maritime accident OR marine accident OR accident OR injury OR unsafe) AND (Maintenance of FSU OR alimentation of FSU)	345
Google Scholar	(Safety culture OR maritime safety OR Safety behaviours OR Safety OR culture) AND (maintenance OR repair OR overhaul OR) AND (Ship OR vessel OR cargo OR maritime transport OR tanker OR Offshore oil storage tanker vessel) AND (Maritime OR marine OR sea OR ocean) AND (shipyard OR ship OR dry dock) AND (Maritime accident OR marine accident OR accident OR injury OR unsafe) AND (Maintenance of FSU OR alimentation of FSU)	134
Science Direct	(Safety culture OR maritime safety OR Safety behaviours OR Safety OR culture) AND (maintenance OR repair OR overhaul OR) AND (Ship OR vessel OR cargo OR maritime transport OR tanker OR Offshore oil storage tanker vessel) AND (Maritime OR marine OR sea OR ocean) AND (shipyard OR ship OR dry dock) AND (Maritime accident OR marine accident OR accident OR	77

	injury OR unsafe) AND (Maintenance of FSU OR alimentation of FSU)	
Web of Science	(Safety culture OR maritime safety OR Safety behaviours OR Safety OR culture) AND (maintenance OR repair OR overhaul OR) AND (Ship OR vessel OR cargo OR maritime transport OR tanker OR Offshore oil storage tanker vessel) AND (Maritime OR marine OR sea OR ocean) AND (shipyard OR ship OR dry dock) AND (Maritime accident OR marine accident OR accident OR injury OR unsafe) AND (Maintenance of FSU OR alimentation of FSU)	13

The inclusion/exclusion criteria were incorporated in the search strings for the Google Scholar and Science direct databases whenever technically possible, as can be seen in the search strings for the Google Scholar and Science direct databases above (i.e., published on or after 2012, in English and a peer-reviewed journal).

On January 23, 2022, the defined search phrases were run in as many database fields as feasible. The literature discovered through these search strings was supplemented with literature discovered through reference lists and bibliographies of pertinent publications.

2.2 Selection Process

According to **Table 3**, the following inclusion/exclusion criteria table was produced using the inclusion criteria put out in this study PRISMA systematic review protocol:

Table 3: Inclusion and exclusion criteria

S/N	Inclusion criteria	Exclusion criteria
1	Articles published in the last 10 years (2012 to 2022)	Articles published before 2011
2	Published in English	Published in other languages
3	Full-text copy is available	Full-text copy is not available
4	Articles focused on safety culture in the maritime industry, and the human factor	Articles do not focus on safety culture, and the human factor (such as road transport, aviation, and petrochemicals) in the maritime industry
5	Non-duplication	Duplication of articles
6	Articles reviewed in peer review generals	Articles not reviewed in peer review generals

When the same search phrase was used in four distinct databases, a substantial number of articles were located in more than one database, resulting in 77 duplications in the total number of articles. While all 569 of the discovered articles were exported to EndNote, the sixth inclusion criteria (non-duplicate study) resulted in all duplicate studies being removed.

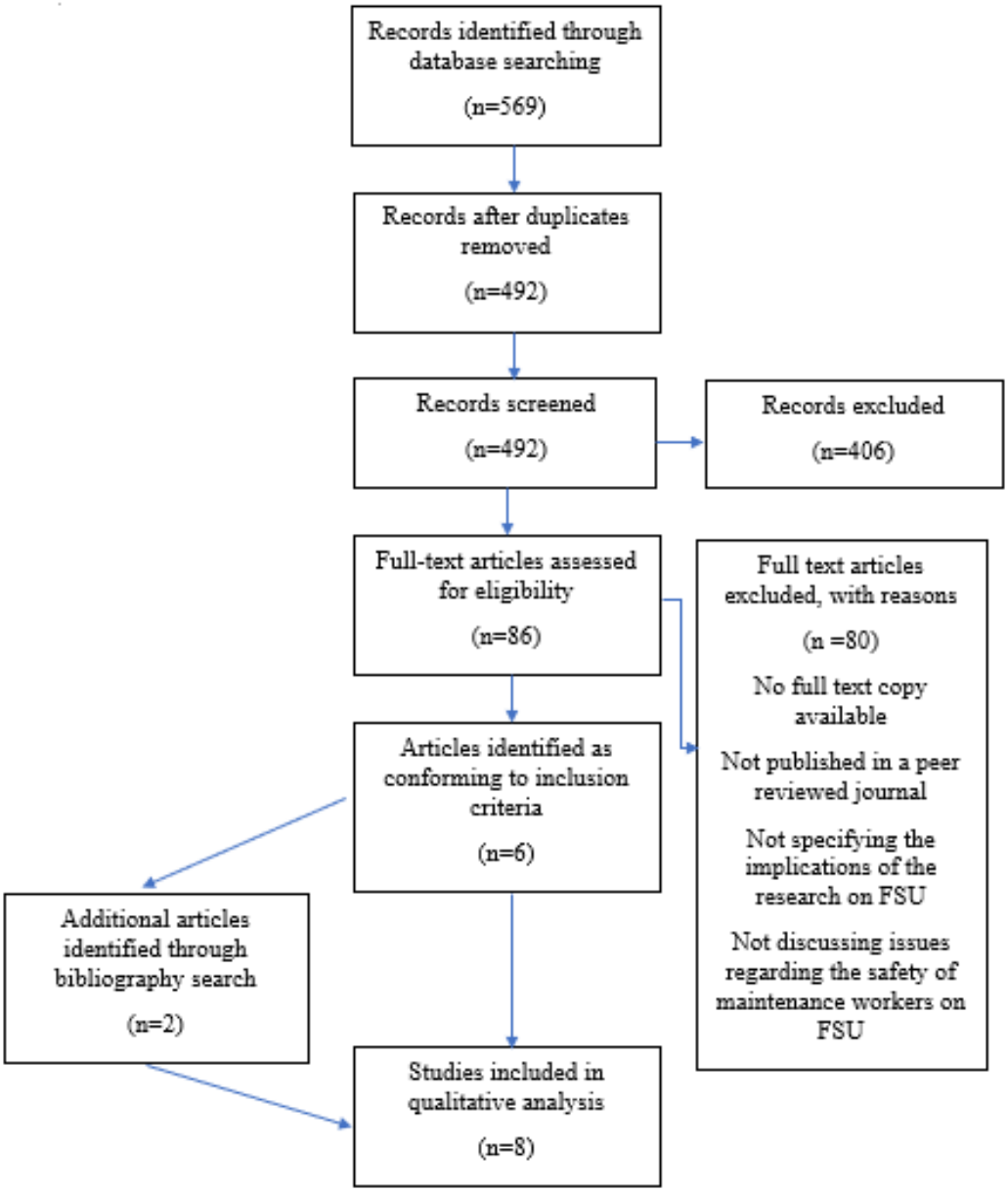

Figure 3: Flowchart of the selection process used in this systematic review

Figure 3 present the flowchart highlighting the selection process utilized in the systematic review. The search started with database search and identification resulting in 569 records to EndNote, where 77 are duplicated which were removed both through manually and automatic algorithm. At first, 492 records were screened using the abstract and title of the papers, then follow with second screening of 86 articles where the studies full text were retrieved, and the exclusion/inclusion criteria were further applied. Six (6) papers bibliographies that were deem fit with the inclusion criteria were screen, resulting into additional two paper added to the list

of the studies in the reviewed section. Lastly, after the selection process completion, 8 papers were highlighted and included in the qualitative analysis (**table 4**).

Table 4: Summary of qualitative analysis of research papers

Author(s)	Year of publication	Title
Tor-Olav Nævestad	2017	Safety culture, working conditions and personal injuries in Norwegian maritime transport
İshak Altinpinar & Ersan Başar	2021	Investigation of the effect of vessel type on seafarers' safety culture
Tor-Olav Nævestad, Kristine V. Størkersen, Alexandra Laiou, George Yannis	2018	Framework conditions of occupational safety: Comparing Norwegian maritime cargo and passenger transport
Shiqi Fan, Jinfen Zhang, Eduardo Blanco-Davis, Zaili Yang Xinping Yan	2020	Maritime accident prevention strategy formulation from a human factor perspective using Bayesian Networks and TOPSIS
Branislav M Ćorović, Petar Djurovic	2012	Marine accidents researched through human factor PRISMA
Nermin Hasanspahi´c, Srdan Vujiˇci´, Vlado Franˇci´c, and Leo Campara	2021	Human Factor Role as it result to accidents in the Marine transport sector
Alexandru Stefan BACIOIU, Alecu TOMA	2017	Maritime accidents of tankers and their consequences

Shih-Tzung Chen	2020	A method of identifying the common human and organisational factors (HOFs) among a group of marine accidents using GRA and HFACS-MA

2.3 Summary of review articles

Table 5 highlights the summary of review papers.

Table 5: Summary of review papers

Author(s)	Country	Design	Outcome
Tor-Olav Nævestad	Norway	Case study	According to studies, decreased manpower numbers result in increased work pressure, which has a detrimental impact on safety culture among the staffs. The respondents on vessels with lower manpower (3–4 people) have lower scores on several study's key variables, including more personal injuries, stress, and a lower rating of the safety culture than respondents on other vessels. The question of whether manpower numbers are too low is not addressed. The safety issues faced by vessels with fewer staffing levels are most likely related to framework issues (i.e.. economy). Given

			the existing staffing levels and framework state, future studies should focus on how to enhance safety culture and working conditions on these boats.
İshak Altinpinar & Ersan Başar	Turkey	Case study	Among officers that graduated from the same college, the vessel type has a substantial influence on safety culture, according to the analysis of variance test. Other factors such as experience, age, and position had little impact on the safety culture among team members who graduated from the same high school and operate in the same setting and department. It is considered that more regular inspections of tanker-type ships improve the safety culture of their crews. Improved and consistent inspections and internal audits for all types of vessels may also help deck officers develop a safety culture.
Tor-Olav Nævestad, Kristine V. Størkersen, Alexandra	Norway	Case study	Crew members in the coastal cargo sector are under higher stress and rank their organization's safety culture poorer than those in the passenger transportation sector. Furthermore, the findings show

Laiou, George Yannis			that job stress and bad organisational safety culture are linked to risky working behaviours, which are linked to the injuries to personnel on board. However, a strong organisational safety culture is linked to safer working behaviours. It is suggested that future studies should look at how organisational safety culture may be used to mitigate the detrimental effects of unfavourable framework circumstances on occupational safety in marine transport.
Shiqi Fan, Jinfen Zhang, Eduardo Blanco-Davis, Zaili Yang Xinping Yan	China	Exploratory	The findings show that knowledge, clear order, and safety culture are the top three suggestions for preventing marine accidents when human variables are taken into account. These techniques should be developed with a higher emphasis to give insights for the enhancement of marine safety in order to prevent accidents caused by human factors. From these vantage points, transportation authorities may learn from previous events and develop effective accident prevention techniques. It would improve to human

			factors and accident investigations research in the maritime sphere, allowing the maritime industry and policymakers to develop successful strategies or suggestions.
Branislav M Ćorović, Petar Djurovic	Montenegro	Case study	It is observed in the study that the lives lost and the number of ships in marine transportation sector dropped between 2007 and 2010. The researchers sought to see if the downward trend will continue in the future. As a result, the linear regression approach was used to describe the number of ships engaged in accidents and the estimated life lost in maritime accidents in EU seas. Though, human error is likely the major cause of the majority of maritime accident. It is stated that the safety culture and crew members' knowledge are possible way number of marine accidents caused by human mistakes can be reduced.
Nermin Hasanspahi´c, Srdan Vujiˇci´, Vlado Franˇci´c,	United Kingdom	Case study	The human aspect and its significance in marine accidents were the focus of this investigation. The authors utilised the HFACS-MA framework to examine

and Leo Campara			maritime accident records from the MAIB database over the previous decade to understand clearly its impact on shipping. The study found that the human component has a substantial impact on the cause of marine accidents and that reducing it might have various advantages. The study found that two human factor categories are predominantly responsible for maritime mishaps and` the number of marine accidents might be lowered if the categories are solved leading to increase in the shipping safety.
Alexandru Stefan BACIOIU, Alecu TOMA	Romania	Case study	When it comes to environmental safety, companies should be dedicated to demonstrating that safe working conditions on board ships are the first concern. Seafarers will think twice before making a move that might have major ramifications for people, ships, cargo, and the environment if a well-implemented safety culture is in place. Leadership, trust, and collaboration are more than simply buzzwords; they're a link between

			compliance management and safety culture. When it comes to preventing marine accidents and their effects, both ship and shore crews play a critical role. With all of this in mind, we may expect a secure future.
Shih-Tzung Chen	Taiwan	Case study	This study proposes a method for identifying organisational and human factors (HOFs) common among a group systematically and quantitatively by combining different analysis i.e., Human Factors Analysis and Classification System for Maritime Accidents (HFACS-MA), why because of analysis (WBA), and grey relational analysis (GRA). The concept of the suggested technique is to use a systematic strategy in addition with numerous step-by-step analytic procedures to reshuffle the common ground of the causative HOFs among a set of accidents. WBA is in charge of identifying the common causal factors, HFACS-MA is in charge of categorising the categories of the identified HOFs for each individual accident, and GRA is

			used in the CHFA to pair these accidents in order to identify the common HOFs between/ among them as the final analysis results. Targeting the most prevalent HOFs is guaranteed to aid the decision-maker in detecting the system's inherent flaws and avoiding similar incidents from occurring in the future more effectively.

2.4 Research gap and research question

While multiple academics have conducted studies into the safety of different maritime transportation industry, the focus has largely been on the safety of transport/cargo ships, leaving a void in the research on the associated safety culture and safety practises in the offshore ships repair and maintenance industry in shipyards. During all my intensive literature review I could not find a single article about the safety culture in Norwegian maintenance shipyards. Nonetheless, workers in the shipyard industry are exposed to similar level of safety risks, accidents, and injuries due to underlying working conditions and organisational safety culture. Based on above mentioned research gaps in the literature, my research question is on occupational safety culture in a Norwegian maintenance shipyard company.

Specific research question:

1. What is the state or level of safety culture in the Norwegian maintenance shipyard?
2. How is the safety culture level in the Norwegian maritime industry?
3. Comparison of safety culture in Norwegian maintenance shipyard VS Norwegian maritime industry.

3 Methodology

The information for this research was gathered from personnel in the maritime maintenance and repair industry with emphasis on occupational safety exposure in Norwegian maintenance shipyard. The primary goal of this research is to examine safety culture and behavior in way to investigate the safety management and practices for Norwegian offshore oil storage tanker or precisely known as Offshore oil storage tanker vessel which was under maintenance at Aibel Haugesund shipyard during the period 2018 - 2022.

3.1 Questionnaire

The questionnaire used in this research was taken from the research paper "Framework conditions of occupational safety: Comparing Norwegian maritime cargo and passenger transport" by author Tor-Olav Nævestad et al. 2018.

Table 6: Samples, survey themes, and analyses used in this study.

Samples(N)
Offshore Offshore oil storage tanker vessel Type: N=107
Key Survey Themes (Questions)
Background variables (15)
Safety performance (8)
Working conditions (4)
Organizational safety culture (11)
Sector focus on safety (6)
One Sample T-test and One-way ANOVA Test
Organizational safety culture index
Demanding working condition index
Unsafe behaviors index

Regression Analyses: Dependent Variables
Personal injuries
Unsafe behaviors index
Organizational safety culture index

The numerous strategies employed in this investigation are summarized in **Table 6**. The survey used in this study took into consideration the account background variables, safety performance (such as safety behaviors, workplace safety assessment, safety compromising fatigue, work accidents, and ship accidents), organizational safety culture, working conditions, and sector focus on safety in relation to Offshore oil storage tanker vessel in Norwegian maritime repair and maintenance industry.

3.2 Recruiting the Respondents

The respondents were contacted through contacts made by a Norwegian maritime maintenance company named as Multi Vedlikehold AS. This company scope of work was surface treatment and coating job at Aibel Haugesund shipyard. As a result, all the responders work on ships that are operated in Norway, and it is implying that the shipping businesses are based there. All staff working on offshore oil storage and processing unit received web links containing the questionnaires, an introductory letter describing the objective and placing emphasizes that the responses will be kept confidential.

3.3 Sample

The Offshore oil storage tanker vessel facility employed all of the respondents (N=102) (precisely the oil storage tank). Similarly, all of the respondents were working on the same Offshore oil storage tanker vessel (Njord Bravo) with seven different nationalities on board and are all owned and operated by the same corporation. This questionnaire was send to 200 workers and feedback was received from 102 workers. The response rate was 51%. Bulgarians

make up 49.02 percent of the respondents, while Greeks make up 50.98 percent. All of the respondents are men. Tables 6–10 summarize the respondents' and their vessels' characteristics based on critical background data.

Table 7: Age distribution among the respondents

	26-35 years	36-45 years	46-55 years	Total
Offshore oil storage tanker vessel	58.82%	31.37%	9.89%	100.00%

Table 7 shows that the youngest group of the Offshore oil storage tanker vessel workers, with 58.82 percent and 31.37 percent of them being between the ages of 26 and 35 years and 36 and 45 years, respectively.

Table 8: Experience distribution among the respondents

	0-5 years	6-10 years	11-15 years	16-20 years	Total
Offshore oil storage tanker vessel	2.94%	71.57%	18.63%	6.86%	100.00%

Table 8 shows that a considerable percentage of respondents (71.57 percent) have 6-10 years of experience, whereas the smallest percentage of respondents (2.94 percent) have less than 5 years of experience. In additional to the numbers of years' experience, nature of organisation in their home country also plays a significant role towards their safety behaviour in international working environment. Personnel who have experience with multinational companies (specially in Germany) have positive behaviour towards safety requirements while personnel who have only experience form the home country typically struggle to catch up with safety requirements in Norwegian shipyards.

Table 9: Position/line of work among the respondents

	Foreman	Sandblaster	Painter	Total
Offshore oil storage tanker vessel	19.61%	34.31%	46.08%	100.00%

Table 9 shows that painters (46.08 percent) are the most common occupation among respondents, followed by sandblaster (34.31 percent), and foreman (19.61 percent).

Table 10: Employment status distribution among the respondents

	Project	Permanent	Temporary	Total
Offshore oil storage tanker vessel	34.31%	64.71%	0.98%	100.00%

According to **Table 10** the majority of respondents (64.71 percent) are permanent employees of the company, 34.31 percent are project employees, and only 0.98 percent are temporary employees of the company.

Table 11: Educational background among the respondents

	Primary	Secondary	Tertiary	Total
Offshore oil storage tanker vessel	51.12%	48.56%	0.32%	100.00%

From the **Table 11**, majority of the respondent had primary education (51.12%) and 48.56 percent had secondary education.

Moreover, I have also observed that education and common communication language have impact of organizational safety culture. As in our current project, a large percentage of workers in the Norwegian shipyard industry comes from Eastern European (Poland, Romania) and southern European countries (Greece, Bulgaria). Where most of these workers had acquired skills to perform the desired work but lacks the desired education level (as all of them have

diploma in their national language only). Consequently, resulting in communication barrier (English or Norwegian), lack of understanding safety requirements to performance the maintenance job. The survey measure used in the research study in presented in Appendix A.

3.4 Analysis of quantitative data

For the data analysis, SPSS version 26 was utilized.

Comparison of means: The one-sample t-test used in the study compares whether the mean scores are equal (null hypothesis) or different (significant) from a given mean value when comparing the mean scores of respondents. The one-way ANOVA test was also performed to compare the mean scores of the various groups.

Regression analysis: In addition, three regression analyses were performed in this study to examine the characteristics that predicted respondents' responses to the dependent variables measuring variables like: personal injuries, unsafe behavior index, and organizational safety culture index. The initial regression analyses used logistic regression analysis. Different independent factors were added to the studies one at a time in order to assess the isolated effect of the independent variables that is when the other variables were kept constant. When the independent variables increase by one value, the B values indicate whether the risk of personal injuries is increases (positive B values) or reduces (negative B values). In the other two studies, hierarchical linear regression analyses were conducted, in which independent variables were added in stages. The most basic independent factors, such as age and position, were added first, followed by the remaining independent variables. Because this is a correlational and cross-sectional study, the findings could not be used to draw any conclusions about causality. When regression studies were detailed, however, the term predict was employed.

3.5 Organizational safety culture

The current section compares the responses of respondents on organizational safety culture considering the personnel working in Aibel Haugesund shipyard for repair and maintenance of Njord Bravo Offshore oil storage tanker vessel, which is in line with the study's primary goal. The measures of the organizational safety culture for the oil storage tank vessel type are shown in **Table 12**. The average safety culture score for an organization is 64.87 points (min = 63.33, max = 70.00). According to Nyestad et al., 2018, Offshore oil storage tanker offshore vessel has a much higher safety culture index than prior research, which found that passenger and cargo transport had a mean safety culture index of 44.4 and 42.1 points, respectively. Based on the one-sample t-test analysis, the respondents' responses are significant (P = 0.000) statistically.

Table 12: Organizational safety culture index mean

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Offshore oil storage tanker vessel	64.87	102	2.71	63.33	70.00

The ANOVA analysis revealed that the age groups gave significant differences with P equals 0.011, the younger respondents was 36 years (63.3 points) scoring the lowest and respondents older than 36 years scoring the highest (70.00 points). The ANOVA analysis also reveals that the positions/lines on work on board gave P=0.000 showing significant variations, the painters score the least (63.33 points) and foremen scoring the highest (64.33 points) (70.00 points). Also, the ANOVA analysis on the positions/lines on work on board gave P value equals 0.000 with the lowest scores was recorded for the painters (63.33 points) and highest the foremen (70.00 points). Finally, the ANOVA analysis on comparing the scores on the different values of the variable: “Sometimes I feel pressured to continue working, even if it is not perfectly safe” also found P = 0.00. The variables with P = 0.00 show the variable is significance.

3.6 Demanding working conditions

The current section compares the responses of respondents working on Njord Bravo - Offshore oil storage tanker vessel at Aibel Haugesund shipyard, which is in line with the study's primary goal. The study created a “Demanding working conditions index of three question”, asking the respondents about the number of duty hours per day, working in night shift and shift changing as a result of the working operations (e.g., port calls). It was observed that the respondents work for 12 hours on an average per day. This duty continues for 14 days (2 weeks) including Saturday and Sundays and after that there is a break of 21 days (3 weeks). Where they have to travel to home country (Poland, Bulgaria or Greece). As noted in Section 2 "Methods." **Table 12** shows the average of the challenging working circumstances index for the personnel working on oil storage tank vessel type. The lowest value is 1 (never) and the highest is 2 (Daily when I am at sea). **Table 13** shows that the demanding working conditions index for personnel working on Offshore oil storage tanker vessel is much higher, with a mean score of 5.61 out of a possible 6.00. Based on the one-sample t-test analysis, the difference between the respondents' responses is significant statistically (P = 0.000).

Table 13: Means of the demanding working conditions index

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Offshore oil storage tanker vessel	5.61	102	0.79	4.00	6.00

Furthermore, there is a significant difference (P=0.005) in the demanding working conditions index across age groups in this study, but no significant difference between positions/lines of work onboard and the demanding working conditions index. Finally, it is observed that the P = 0.00 when comparing the scores on the variable: “Sometimes I feel pressured to continue working, even if it is not perfectly safe” with “totally disagreed” option scoring the least point with 4 points, while the ‘‘totally agreed” had the highest (6 points). However, the ANOVA

analysis on the comparison of the scores on the safety culture index on the variable "Sometimes I am so tired during working hours that safety is compromised" was not possible because all the respondents agreed to this.

Table 14 displays the mean scores for the personnel working on oil storage tank vessel the variable "Sometimes I feel forced to continue working, even if it is not absolutely safe" (1 = totally disagree, 5 = totally agree). According to the findings of Nvestad et al. (2018), oil storage tank offshore vessel had higher work pressure (mean value of 3.41) than freight and passenger transport (mean values of 1.4 and 1.7, respectively). At the 5% level, the difference between the respondents' responses is (P = 0.000) significant.

Table 14: Mean scores on the variable work pressure

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Offshore oil storage tanker vessel	3.41	102	0.81	3.00	5.00

3.7 Safety outcomes

The current section determines the safety results for the personnel working on oil storage tank vessel, in accordance with the study's second goal: first, the respondents' replies on safety behaviors were compared, and then the respondents' responses on personal injuries were compared.

3.7.1 Safety behaviors

In this study, four questions were used to create an index that measured unsafe behaviors: infractions, risk-taking, and risk acceptance. The study compared the respondents' mean scores on this variable in **Table 15**. The least value is never (4) and the 28 as the greatest out of every hundred working days on board, more than 20 times). 18.36 is the average score. **Table 15** shows that personnel working on Offshore oil storage tanker vessel scored much higher on the

unsafe behavior index than earlier research, which found that cargo and passenger transport had mean safety culture indexes of 9.5 and 6.6 points, respectively (Nvestad et al., 2018). Based on the one-sample t-test analysis, the difference between the respondents' responses is statistically significant (P = 0.000).

Table 15: Means on the index measuring unsafe behaviors

Vessel type	Mean	N	Std. Deviation	Minimum	Maximum
Offshore oil storage and processing vessel	18.36	102	1.51	17.50	21.00

The results show significant variations between age groups (P = 0.010), with younger respondents (below 36 years) received the highest scores (21.00 points) and respondents above 36 years receiving the lowest point (17.50 points). Similarly, substantial disparities (P = 0.00) exist between positions/lines of work onboard, with Foremen ranking the highest (21.0 points). Also, when comparing scores on the variable: “Sometimes I feel pressured to continue working, even if it is not perfectly safe”, the study discovered significant differences (P = 0.00): respondents with "totally agreed" option scored the highest (21.0 points), while those with “totally disagreed” scored the lowest (17.5 points). Finally, the results based on the one-way ANOVA analysis found that the P value equals 0.000 showing significant differences on the working conditions demand. Thus, the unsafe behaviors had a close relationship with the working condition demands.

3.7.2. Personal injuries

The respondents to this study's questionnaire were questioned if they had been harmed while working onboard in the previous two years. "Yes, a minor injury that necessitated medical attention," said 101 of the respondents (99.02 percent). For values on the personal injury variable, the graph gives the unsafe behavior index mean scores.

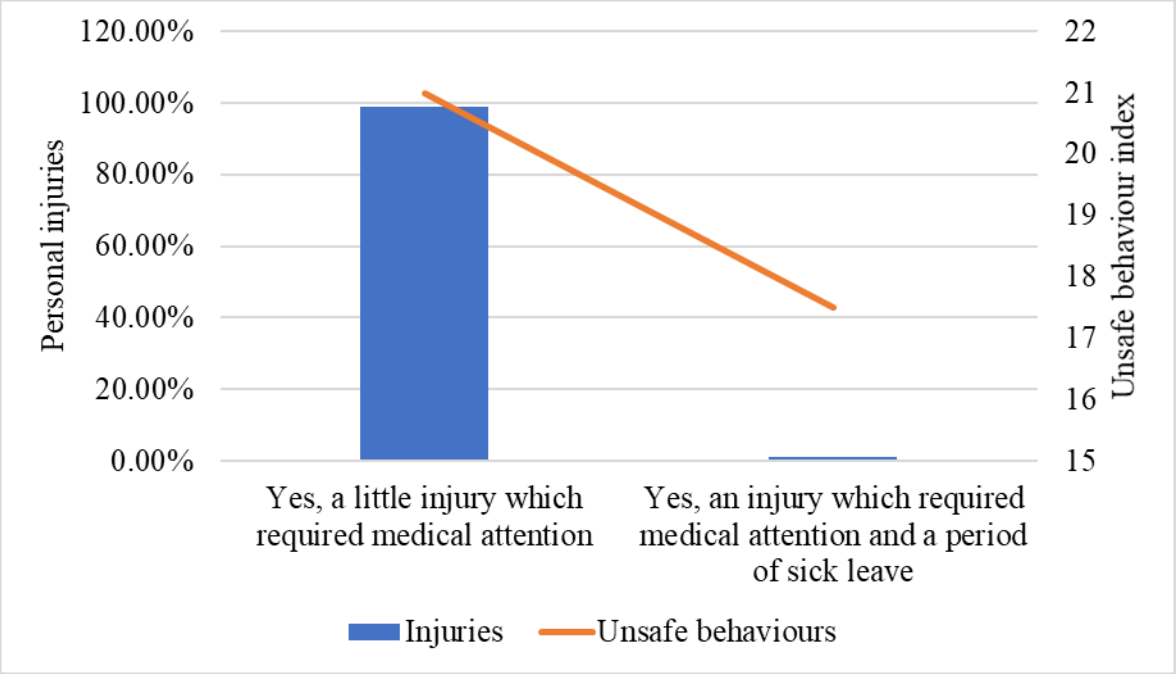

Figure 4: Feedback from respondents on the questions

Figure 4 shows a link between personal injuries and risky behavior. It is observed that respondents who have experienced an accident that call for medical treatment and a time of sick leave have a lower average unsafe behavior index score, indicating that they have learned from their mistakes. The difference between the responses of the respondents on the personal injury variable is significant (P = 0.000) based on the one-sample t-test analysis.

3.8 Sector attention on safety Offshore oil storage tanker vessel

The current section contains results on the questions measuring the sector safety attention for the personnel working for the maintenance of the offshore oil storage vessel, in accordance with the study's third goal (precisely the oil storage tank). The extent the questions measure the framework circumstances is also discussed in this study. The study's key hypothesis is that the framework conditions (e.g., regulation, competition, and economy,) differ in oil storage tank transportation. It's also worth noting that the current study incorporates survey measures focused on sector attention on safety, which might be employed in Norwegian Maritime

maintenance shipyard industry. Significant differences between the passenger and freight sectors are shown by P-values.

Table 16: Mean scores on measuring sector focus on safety

Statements measuring sector culture/focus on safety	Mean	P-value
Q1: Offshore oil storage tanker vessel	7.24	0.000
Q2: "safety level scale" ranges between 1 and 10, based on the question "how would you rate your sector (i.e. sea transport of oil storage tanks)"? while the value 10 stands for the safety level aviation sector (International),	3.98	0.000
Q3: "Safety is more important than deadlines to our customers"	3.98	0.000
Q4: "Safety is more important than price to our customers"	3.98	0.000
Q5: "Strong competition between companies impedes safety in my sector"	4.00	0.000
Q6: "I don't expect safety improvements in my sector in the next 10 years"	2.00	0.000
Q7: "Society accepts the current level of accidents that we have in my sector."	3.61	0.000

P-value is a statistical quantity that is used to test a hypothesis against actual facts. The statistical significance of the observed difference increases as the p-value decreases. $P > 0.05$ is the probability that the null hypothesis is true, and it showed statistical significance.

Table 16 indicates significant differences between respondents on the issues regarding sector focus on safety in this study. Because prior research has shown that multiple safety levels ("reference points") exist in the same industry (maritime maintenance), but for different vessel

types, it may be of great interest to enquire from the respondents to compare their own vessel type to a relatively well-known vessel type in the same industry (i.e., cargo and transport).

The justification for the two customer-focused questions ("Safety is more important to our customers than price/deadlines") is that research shows that customer focus on safety is a key framework condition (e.g., Strkersen, 2017; Nvestad et al., 2018). It should be emphasized, however, that the concept of "clients" differs significantly depending on the sort of vessel being transported. Nevertheless, in this research study, there was a statistically significant difference between respondents' responses working on the maintenance of oil storage offshore vessels when it came to safety vs. deadlines, indicating that respondents working on oil storage tank vessels place more weight on safety (vs. deadlines), with a mean of 3.78 (Nvestad et al., 2018). On the subject of safety vs. price, the difference was similarly statistically significant. The same can be said for the question of "strong competition." Although the baseline level of safety is better in this type of vessel, competition may be considered fierce in the examined offshore maritime maintenance industry (given e.g., the customer focus on safety). ("I don't expect...' and "Society accepts...') in the oil storage tank, the vessel may also assume differing baseline levels, making comparisons impossible. If very high safety level is observed, it may be difficult to expect further improvements.

The answer to the Q1 range from 1 to 10, and 1 (totally disagree), to 5 (totally agree) are the answer to last five questions. Finally, P-values indicate statistically significant stating between the sector's mean scores.

4 Results

4.1 Regression Models

4.1.1 Personal injuries on board as the dependent variable

The characteristics predicting personal injury among the respondent was investigated using the linear regression undertaken using the personal injuries as the dependent variables and the effect of the sector controlled as the other relevant variables.

Table 17: Logistic regression – personal injuries

Dependent variable: Personal injuries on board in the last two years. B values.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Age group	-0.061	-0.133	-0.152	-0.152	-0.152	-0.152
Position/line of work		16.806	16.683	17.998	18.998	18.398
Unsafe behaviour index			-4.448	-5.113	-6.113	-4.113
Demanding working conditions index				-18.199	-18.199	-17.123
Sometimes I feel pressurized to continue working, even if it is not perfectly safe					**-1.299***	12.089
Organizational safety culture						0.906
Nagelkerke R^2	0.007	0.176	0.206	0.206	1.000	0.973

Bold values indicate that contributes statistically significant, and the significance levels are indicated by the * = 5 % level of significance.

The dependent variable was dichotomized in this analysis, with 0 (Yes) as the minor injury that did not need medical attention and 1 (Yes) as the serious injury that required medical attention and a period of sick leave. Hence, increasing the independent variables by one, the B values are presented in **Table 17** to indicating whether the personal injury increased (positive B values) or reduced (negative B values). The different independent factors were added in the

analyses step by step in this study to determine the influence of the independent variables in isolation, that is, when the other variables were kept constant. **Table 17** shows two significant findings. When the other variables in the model are adjusted, the age group adds negatively and insignificantly to the chance of experiencing a personal injury. The other major conclusion in **Table 17** is that at the 5%-level in Step 5, "sometimes I feel pressured to continue working, even if it is not safe" contributes negatively and considerably to personal injuries. This implies a strong link between job pressure and personal injury onboard the vessel under investigation. The variation in the dependent variable that explains the independent variables in the models is shown by the Nagelkerke R2. The Nagelkerke R2 in Step 5 of **Table 17** is 1.00, indicating that the independent factors account for 100% of the variation in the dependent variable, personal injuries.

4.1.2 Unsafe behaviors index as the dependent variable

The unsafe behaviors index forecast the injuries to personal in the last two (2) years, as shown in the previous result.

Table 18: Logistic regression - unsafe behaviour

Dependent variable: unsafe behaviors index. standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4	Step 5
Age group	**-0.03***	**-0.103***	**0.177***	-0.056	-0.056
Position/line of work		**-2.450***	**-1.336***	1.819	1.787
Demanding working conditions index			**-0.934***	**-2.223***	**-0.223***
Sometimes I feel pressurized to continue working, even if it is not perfectly safe				**2.526***	**3.126***
Organizational safety culture					**-0.906***
Nagelkerke R^2	0.308	0.176	0.719	0.847	1.000

Bold values indicate that contributes statistically significant, and the significance levels are indicated by the * = 5 % level of significance.

Table 18 shows the findings of a hierarchical from the linear regression study, which independent variables are incorporated in consecutive steps to investigate the variables that predict unsafe behaviors of the respondents. The findings in the study is in harmony with the study's second goal, which is to look into the factors that influence safety outcomes. The standardized beta coefficients are shown in **Table 18**. Various independent variables as it influences the dependent variables may thus be directly compared. The dependent variable scores range from never (4) to 28 (for more than 20 working days/nights onboard every 100 working days/nights). As previously stated, this index assesses infractions as well as risk-taking and acceptance. The average score is 18.36.

Table 18 shows two main findings. The first major finding is that when other variables are adjusted for, the safety-compromising job pressure had significant and positive impact on the risky behaviors. This suggests that the more the respondents are exposed to work pressure, the more likely they engage in risky behavior. The respondents' score on the unsafe behavior index rises with each increase in this variable's value. The second major finding is that organizational safety culture has a negative and significant impact on risky behavior. This means that the higher the respondents' company safety culture scores, the less risky their behaviors are. This finding suggests that, to some extent, corporate safety culture might mitigate the detrimental effects of unsafe behavior in the oil storage vessel transportation industry. The Nagelkerke R^2 measures how much variance in the dependent variable is explained by the model's independent variables. The Nagelkerke R^2 in Step 5 is 1.00, indicating that the independent variables account for nearly 100% of the variation in the dependent variable.

4.1.3 Organizational safety culture index as the dependent variable

The organizational safety culture measure was previously found to be one of the predictors of respondents' unsafe behaviors.

Table 19: Logistic regression - organizational safety culture

Dependent variable: organizational safety culture index. Standardized beta coefficients.

Variables	Step 1	Step 2	Step 3	Step 4
Age group	**0.036***	**0.213***	**0.297***	-0.312
Position/line of work		**-5.170***	**-3.497***	2.516
Demanding working conditions index			-1.156	-12.358
Sometimes I feel pressurized to continue working, even if it is not perfectly safe				19.000
Nagelkerke R^2	0.394	0.910	0.917	1.000

Bold values indicate that contributes statistically significant, and the significance levels are indicated by the * = 5 % level of significance.

Table 19 presents the findings of linear regression analysis, in which the independent variables are incorporated in consecutive levels needed to analyze the variables determining organizational safety culture, in accordance with the study's primary goal. The standardized beta coefficients are shown in **Table 19**. The dependent variable's scores range from 63.33 to 70. **Table 19** summarizes the key findings. The first is that age affects corporate safety culture in a good and important way. When the other variables in the model were adjusted, respondents above 36 years old graded their corporate safety culture high compare with the other respondents. The second result shows that work pressure contributes insignificantly to safety culture in the organization. This is the variable in the model that has the greatest impact. The

Nagelkerke R^2 measures how much variance in the dependent variable is explained by the model's

independent variables. The Nagelkerke R^2 in Step 4 is 1.000, indicating that the independent variables account for nearly 100% of the variation in the dependent variable.

5 Discussion

In comparison to earlier maritime activities, the Norwegian maritime industries have gotten steadily safer in recent decades. Maritime industry standardization and codification increased the reliability and safety of operations during the twentieth century, reducing accidents and incidents at sea. However, 1,129 ships are lost at the sea in the past decade (Allianz, 2018) and organisational safety culture has been identified as the main source of the maritime accidents coupled with demanding working conditions and unsafe behaviour leads to increased personal injuries.

A comparison of Norwegian maritime transport and Norwegian maintenance shipyards shows improved organizational safety culture has been summarised as under; According to the Tor-Olav Nævestad et al. 2018, the highest safety culture index achieved on a Norwegian maritime transport ship/cargo vessel was 46.5. However, the average safety culture index obtained in this study is 64.87 which shows that the Norwegian maintenance shipyard industry has a much higher safety culture index as compared with Norwegian maritime transport industry.

Similarly, the unsafe behaviour index indicated on a Norwegian maritime transport ship/cargo vessel was lower as compared to the Norwegian shipyard maintenance industry. Moreover, personal injuries index achieved on a Norwegian maintenance shipyard was higher as compared to the maritime transport ship/cargo vessel.

In line with the research findings, two key features might further improve the safety culture in the Norwegian maintenance shipyard which is adherence to the shipyard safety guideline and risk perception. The risk perception of the maintenance shipyard staff affects their perception and understanding of safety threats during the repair and maintenance activities. Hence, to achieve optimal awareness and understanding of certain job tasks and activities, it is critical to find the best fit between the workers and the organisational safety culture management system.

Also, the individual's background, level of education and previous experiences influence their perceptions of safety (Oltedal et al., 2004) and the decision they made. This affects the safety culture at the shipyard since the individuals share the responsibility of safety-critical environment and depend on one another (collective responsibility). This research study examined the safety compliance of the shipyard worker by investigating the worker's safety perception, prioritization, commitment and trust in the system. The use of safety rules and regulation should be considered a top priority.

6 Conclusion

This research aimed to examine the organisational safety culture and unsafe behaviour in the Norwegian maritime maintenance industry by investigating the organisational safety management and practices in the offshore oil storage tanker vessel repair and maintenance shipyards. The survey used in this research study took into consideration the account background variables, safety performance, organizational safety culture, working conditions, and maritime sector focus on the safety of the personnel working in the Norwegian maintenance shipyard. The results of organizational safety culture and unsafe behaviour and personal injuries were presented in section 4. Therefore, it can be concluded that the primary aim of this thesis was achieved.

The average organisational safety culture index obtained in this study was 64.87 and it shows that the Norwegian maintenance and repair shipyard has a much higher organisational safety culture index when compare with the Norwegian maritime transport industry. Also, there is link between personal background, previous experience, demanding working conditions, unsafe behaviour and personal injuries which shows that the correspondent understanding of complexity of situation awareness. Hence, it is encouraged that both Norwegian maritime transport and Norwegian maritime maintenance shipyards sector should be encouraged to invest more on enhanced organisational safety culture and systematic reduction of unsafe behaviour leading to personnel injuries. As everyone working in Norwegian maritime sector have an equal right to work safely and return home safely after work (Alle skal trygt hjem!).

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Appendices

The questionnaire used in this research was taken from the research paper "Framework conditions of occupational safety: Comparing Norwegian maritime cargo and passenger transport" by author Tor-Olav Nævestad et al. 2018.

Appendix A: Survey Measures

1) **Background Variables** (15 questions): It includes the sex, age group, nationality, seafarer experience, employment status, educational background, position/area of work, vessel size, vessel type, ship register, manning onboard, days onboard and days off, year vessel was built, number (and share) of nationalities on board, work schedule, and number of employees in the shipping company.

2) **Safety performance** (8 questions) (Classified into 2a-2e):

a. ***Safety behaviours*** (4 questions): How often do you think the following events tend to occur for every 100 working days/nights onboard?

- I violate procedures to get the job done
- I refrain from using the required protection equipment in my work
- I accept small risks because the ‘‘situation demands it" (e.g. because of time pressure, bad weather)
- I work, even though I am so tired that safety may be compromised

(Answer alternatives: (1) Never, (2) 1–2 times, (3) 3–5 times, (4) 6–10 times, (5) 11–15 times, (6) 16–20 times (7) More than 20 times, 8) Do not know/not relevant). The last answer alternative is excluded from the index.

b. ***Workplace safety assessment*** (1 question): All in all, how do you assess the safety of your workplace situation (applies both to personal injuries and ship accidents)?

(Answers are provided on a scale of 1–10, where very bad = 1 and very good = 10)

c. ***Safety compromising fatigue*** (1 question): Sometimes I am so tired during working hours that safety is compromised

(Answer alternatives: 1 = totally agree - 5 = totally disagree, 6 = Do not know/not relevant)

d. ***Work accidents*** (1 question): 'Have you been injured in your work onboard in the course of the last two years?

(Answer alternatives: (1) No, (2) Yes, a little injury that did not require medical attention, (3) Yes, a little injury that required medical attention, (4) Yes, an injury that required medical attention and a period of sick leave).

e. ***Ship accidents*** (1 question): Has the vessel been involved in a shipping accident in the two last years?

(Answer alternatives: (1) No, (2) Yes)

If yes, what kind of ship accident?

(Several answers are possible. (1) Grounding, (2) Collision, (3) Contact damage (dock, bridge etc.), (4) Foundering, (5) Other accident (please specify))

3) **Working conditions** (4 questions): How often do you think the following events tend to occur for every 100 working days/nights onboard:

- Your shift change is delayed because of work operations, for instance, port calls?
- Do you work more than 6 hours in the course of a 24-hour period?
- You are interrupted when you are off duty

(Answer alternatives: (1) Never, (2) 1–2 times, (3) 3–5 times, (4) 6–10 times, (5) 11–15 times, (6) 16–20 times (7) More than 20 times, (8) Do not know/not relevant)

‘‘Demanding working conditions index” was made of these three questions. The survey also included a question on work pressure:

- Sometimes I feel pressured to continue working, even if it is not perfectly safe

(Answer alternatives: 1 = totally disagree - 5 = totally agree, 6 = Do not know/not relevant).

4) **Organizational safety culture** (11 questions): An organizational culture index, consisting of 11 questions from the GAIN-scale on organizational safety culture was made. (Answer alternatives range from 1 = totally disagree, to 5 = totally agree):

- Ship management regards safety to be a very important part of all work activities.
- The shipping company regards safety to be a very important part of all work activities.
- Ship management detects crew members who work unsafely.
- Ship management often praises crew members who work safely.

- My colleagues on board usually report all safety problems and unsafe situations that they experience in their work.
- My colleagues on board do all they can to prevent accidents and unwanted incidents.
- There are routines (procedures) on board for reporting safety problems.
- All defects or hazards that are reported are corrected promptly
- After an accident has occurred on board, appropriate actions are usually taken to reduce the chance of reoccurrence
- All crew members on board receive adequate training to work in a safe way
- Safety on board this vessel is better than on other vessels

(5) **Sector focus on safety** (6 questions):

- On a "safety level scale" ranging from 1 to 10, where 10 equals the safety level in international commercial aviation, how would you rate your sector (i.e. sea transport of oil storage)?

The survey included five additional questions measuring sector focus on safety (answer alternatives range from 1 = totally disagree, to 5 = totally agree):

- Safety is more important than deadlines to our customers
- Safety is more important than price to our customers

- Strong competition between companies impedes safety in my sector
- I don’t expect safety improvements in my sector in the next 10 years
- Society accepts the current level of accidents that we have in my sector.