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Understanding SIRE 2.0 Through Human Experience:

Crew and Inspector Perspectives in Tanker Shipping

Master's thesis in Maritime Management Program

BERK PALA
FARHAD HAJALIGHOLI

Chalmers School of Maritime Studies

CHALMERS UNIVERSITY OF TECHNOLOGY
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BERK PALA
FARHAD HAJALIGHOLI

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Chalmers School of Maritime Studies
Chalmers University of Technology
SE-412 96 Göteborg
Sweden
Telephone: + 46 (0)31-772 1000

Chalmers School of Maritime Studies
Chalmers University of Technology
Göteborg, Sweden, 2026

PREFACE

This master's thesis represents 30 out of the 120 total credits of the two-year maritime management program at Chalmers University of Technology, in the Department of Maritime Studies. This thesis investigates how the implementation of SIRE 2.0 included human factors on tanker vessels. The study focuses on gathering insights from maritime professionals who are involved in inspection processes.

We thank all participants of this study. A very big thanks to our supervisor, Monica Lundh, for her contribution and support throughout the process. Lastly, we thank our families and partners who supported and patiently waited until this thesis came to its final form.

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Berk PALA
FARHAD HAJALIGHOLI

Chalmers School of Maritime Studies
Chalmers University of Technology

ABSTRACT

In the shipping industry, especially in the tanker business, inspections and vetting procedures have significant importance as part of operational safety and commercial readiness. Introduction of the SIRE 2.0 by OCIMF made a huge impact to change the philosophy of the inspection procedures by shifting the checklist-based system toward a human-centered and evidence-based approach. This thesis explores how SIRE 2.0 affects the work environment, workload, operational efficiency, and human factors onboard tanker vessels. This study was conducted through semi-structured interviews with crew members and maritime professionals and analyzed by using thematic analysis of the obtained empirical data. The results indicate that SIRE 2.0 has brought a better structure, predictability, awareness of procedures, and communication during inspections. The new regime solidified the safety culture and created a more structured inspection process. At the same time, findings also point out that the new inspection system has generated additional administrative workload, increased procedural pressure, and demands higher expectations regarding continuous preparedness. The study also suggests that while SIRE 2.0 aims to standardize inspections, the inspections continue to be influenced by inspectors' perspectives. The SIRE 2.0 should not be understood only as a technical inspection regime but as a socio-technical system that impacts operations onboard by evaluating behavioral aspects of crew members in order to build up a safety culture on the tanker vessels.

Keywords: SIRE 2.0, tanker industry, ships, human factors, workload, work environment, safety culture, inspections, operational efficiency

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Abbreviation List

AB	Able Seaman
BIMCO	Baltic and International Maritime Council
EU ETS	European Union Emissions Trading System
GDPR	General Data Protection Regulation
IMO	International Maritime Organization
ISM Code	International Safety Management Code
LNG	Liquefied Natural Gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MLC	Maritime Labour Convention
OCIMF	Oil Companies International Marine Forum
RQ	Research Question
SIRE 2.0	Ship Inspection Report Programme 2.0
SMS	Safety Management System
SOLAS	International Convention for the Safety of Life at Sea
STCW	Standards of Training, Certification and Watchkeeping for Seafarers

1. Introduction

1.1 Background

The shipping industry is one of the most important sectors in the global economy, with around 80-90% of world trade transported by sea(UNCTAD,2023). Maritime transport is essential for global trade and economic stability since ships enable international trade of energy resources, raw materials and manufactured goods. In this sector, tanker shipping plays crucial role by carrying around main energy resources which are also hazardous cargoes such as crude oil, chemicals, and liquefied gases. Nature of these cargoes forces operations of tanker vessels to be meticulous since environmental, and safety related risks are significant (IMO, 2023).

Although developments in technology and international regulations have improved safety at sea over recent decades, the shipping industry is considered as a high-risk work environment. Research has shown that many maritime accidents are not caused only by technical failures but also strongly related to human factors such as workload, communication failures, fatigue, decision-making and organizational culture (Bloor et al., 2013; Aarskog et al., 2020). Especially, when it comes to tanker shipping, even minor operational errors can have serious consequences on the environment and the economy.

The International Maritime Organization (IMO) has developed Safety of Life at Sea (SOLAS), the International Convention for the Prevention of Pollution from Ships (MARPOL), and the International Safety Management (ISM) Code to establish minimum standards through these frameworks, regarding ship safety, operational procedures, and pollution prevention (IMO, 2014; IMO, 1974; IMO, 1978). Alongside these regulatory developments, further safety initiatives were introduced by the tanker industry and one of the most influential one was the Ship Inspection Report Programme (SIRE) which is developed by the Oil Companies International Marine Forum (OCIMF, 2022).

In 1967, after the Torrey Canyon accident, which is one of the biggest human-caused disasters, accelerated the need for development of vetting systems, as it had shown weaknesses in tanker safety governance and increased pressure from cargo owners for more reliable safety assessment systems (Wells, P. G. 2017). Over time, SIRE system became a must to trade within tanker sector, as compliance with vetting requirements strongly impacts the image of the vessels. Improvements in technical standards and operational control across the tanker industry is provided by the system (OCIMF, 2022).

Despite these improvements, previous research indicates that checklist-based compliance was no longer sufficient to improve safety culture and has reached a plateau (Aarskog et al., 2020). Traditional inspection systems were mainly concerned with confirming documented compliance and technical conditions, while providing limited insight into human-centered behavioral approaches to operations onboard. At the same time, digitalization, efficiency concerns, and compliance requirements increased the administrative and operational demands, which resulted in higher workload and psychosocial strain for both onboard and shore-based personnel (Baygi et al., 2022).

As a result, OCIMF decided to introduce SIRE 2.0 to integrate human factors to develop a stronger safety culture and more realistic inspection process. However, implementation of the new system raised questions regarding workload and complexity. As new system introduced more procedures, potential increase in workload and cognitive demand frightened crew members in terms of exposure to stress and overall well-being which might lead to an impaired work environment (Flin et al., 2000).

1.2 Purpose and research questions

The main purpose of this thesis is to investigate how the implementation of SIRE 2.0 affects workload, work environment, and operational practices within tanker shipping operations. In addition to its main purpose, the thesis aims to examine how the human-centered approach to inspections influences work efficiency, safety culture, and the psychosocial working environment on board vessels.
The research questions prepared in accordance with the purposes stated above are as follows:

RQ1 – How has the introduction of SIRE 2.0 affected workload and the work environment for crew members on board tanker vessels?

RQ2 – How has SIRE 2.0 influenced operational efficiency within the tanker industry?

The goal of these research questions is to determine the experiences of SIRE 2.0 as expressed by crew members and inspectors, and to evaluate whether the feedback from these experiences affects current transport practices.

1.3 Limitations

This thesis specifically focuses on the implementation of SIRE 2.0 on tanker vessels within the tanker sector. Tanker vessels operate under special safety requirements since they carry hazardous cargoes and undergo strict vetting procedures. The findings of this study may not be directly transferable to other shipping sectors, as their operation and inspection practices slightly differs from tanker vessels (Bloor et al., 2013).

Swedish tanker operators, crew members, and shore-based personnel were the target of this study to collect empirical data. Different organizational cultures and management structures may impact how SIRE 2.0 is experienced. Therefore, the findings should be interpreted within the context of the tanker industry and the operational environment represented in this study. Since SIRE 2.0 is a fairly new system, there is currently a limited amount of academic literature on it. Therefore, some analyses of relatively new systems are based on broader research focusing on human factors and safety culture in safety-critical industries to understand their impact on inspection systems (Flin et al., 2000).

This study applies a qualitative research approach based on semi-structured interviews and thematic analysis. The purpose of the thesis is to explore how the new inspection framework is experienced by maritime professionals rather than measuring the statistical safety

performance of SIRE 2.0 by understanding impacts on workload, daily practices and the working environment onboard tanker vessels.

2. Theory

The literature review provides a foundation to explain how the inspection process impacts efficiency, working environment, and daily work on tanker vessels.

2.1 The Tanker Shipping Industry as a Safety-Critical System

The tanker shipping industry has significant importance due to the cargoes carried all over the globe. Petroleum-based and hazardous liquid cargoes to be used as energy sources in many industries. Considering the scale of operations and risks associated with the cargoes transferred by vessels, defines tanker segment as one of the most safety-critical environments in the maritime industry (Moldanova et al., 2022). Tanker accidents can cause severe environmental, economic and social consequences, and to remedy these consequences are quite difficult compared to other industries. As a result, tanker operations have always been under the scope of regulatory foundations, under continuous inspections to verify quality and safety standards (Aarskog et al, 2020).

Tanker shipping is characterized by interactions between human-related operations, advanced technical systems, organizational routines, and external frameworks to set quality measures. Not only the crew that operates systems on board, but also management systems and regulatory compliance play a big role in the assurance of technical quality and in preventing accidents (Flach, 2012). The complex environment of shipping, especially the tanker segment, calls for strict regulations and private governance mechanisms to control risk factors to ensure high safety standards. Understanding tanker shipping as a safety-critical socio-technical system is crucial to be able to examine the effectiveness of vetting frameworks such as SIRE 2.0.

2.1.1 Characteristics of Tanker Operations

Maritime sector requires punctuality; general cargo , bulk or containers , tanker vessels are working under strict time constraints set by terminals which may increase operational pressure. Thus, operational and management personnel do their best to reach required arrival time while ensuring safety and sustainable operations (Panayides,2019).

The consequences of tanker accidents are often severe, not only vessel itself but coastal environment, port infrastructure and trust that built up over the years in maritime sector can be damaged. To prevent these unwanted situations tanker shipping is strictly regulated and continuously overseen by public authorities and private stakeholders. The combination of type of cargo, time sensitivity and complex procedures make tanker shipping as a segment where adherence to operational discipline is a necessity to comply with regulations and assurance of safety performance(Bloor et al., 2013).

2.1.2 Operational Routines and Cargo Handling Complexity

Demanding operational procedures on tanker vessels are highly standardized. Loading, discharging, inert gas management, tank cleaning, purging and cargo heating processes

requires precise execution and collaboration between personnel on board – deck officers, engineers and shore-based personnel. As well as regulatory compliances strict procedures facilitate oversight over operations in order to prevent fires, explosions or pollution incidents (Panayides, 2019).

Aside from cargo operations, tanker crews must handle navigation challenges such as congested area sailing, comply with discharge-loading port requirements and prepare for inspections and internal-external audits. Previous studies shows that such operational density and workload demand error-free actions especially during time-critical phases of operation. Therefore, human performance and organizational coordination become significantly important to ensure safe and effective operations by not solely relying on technical reliability (Kim et al., 2016).

2.1.3 Work Environment and Psychosocial Conditions onboard Tankers

The work environment on board tanker vessels, aside from physical challenges, are recognized psychologically demanding. Seafarers are exposed to overtime hours, extended periods of isolation and responsibility over hazardous cargo operations (Baygi et al,, 2022). These demands are elevated by need of frequent inspections, documentation requirements and demonstration of compliances with both regulatory and commercial standards.

Research on maritime occupational health have focused on stress and fatigue to identify persistent human mental health challenges in tanker operations. In particular, fatigue is linked to reduced situational awareness and increased accident risks (Gander et al., 2017). International frameworks such as Maritime Labour Convention (MLC) establishes minimum standards for rest hours and working conditions. But research shows that it lacks in dealing with operational pressures and organizational expectations. Thus, the importance of human effect on safety performance is undeniable, and the environment of tanker shipping highlights it as an integral component (Baygi et al., 2020).

2.2 The Human Element in Maritime Safety

The human element in maritime sector Is recognized and accepted as core element of the safety in recent years, especially in tanker sector which requires meticulous safety awareness. In the early stages of maritime safety standardization, technical advancements were prioritized in order to comply with regulations since then observations indicated that human element has such major impact on practices. In tanker shipping, where operations are critical and possibly fatal, human interactions with engine room and deck equipment were kept under investigation for verification of safe operations (Kim et al.,2016; Aarskog et al., 2020).

When considering the systems, tanker shipping exhibits characteristics of a high-reliability organization (HRO), where failures are rare, but consequences risk being fatal. In those environments, safety depends not only on preventative actions but also monitoring and fault detection, managing and recovering in case of emergencies. This shifts the focus from individual fault finding toward understanding performance variability, behavioral adaptation and systemic constraints. As a result, human element is not seen as a weak link but as a core of the system resilience and safety performance (Roberts , 1990).

2.2.1 Human Factors and Socio-Technical Systems

In theory, tanker shipping can be seen as a socio-technical system in which safety outcomes are evaluated as an interaction between technical systems and organizational structures. Dynamic interactions characterize complex systems where changes in any aspect of organization or procedure influence other components. In tanker operations, this means that behavior of crew members, implementation of procedures, management decisions and compliance to safety protocols and legislations are interdependent elements of a general safety system (Flach, 2012).

Research in maritime safety emphasizes that effective risk management systems must consist of actual examples to perform specific tasks rather than vague prescriptions Tanker crews operate in environments where workload, time pressure and administrative demands can have significant impact on decision-making and performance. Thus, safety cannot be treated as a pure regulatory or technical issue, but it should be conceived as a dynamic process shaped by human capabilities, organizational procedures and external pressures. This socio-technical perspective provides a foundation for the assessment of inspection and vetting systems that interact with tanker operations (Kim et al., 2016).

2.2.2 Workload, Fatigue and Psychosocial Risk

Workload and fatigue are one of the main causes of major accidents in the past shipping accidents. In tanker shipping, overtime work mostly happens during cargo operations, bunker operations, port arrivals (maneuverings), inspections and emergency drills where crew must manage operational tasks simultaneously as well as cargo related documentation, communication, and safety monitoring. Fatigue blatantly affects cognition and such workload accumulation leads to chronic fatigue which impairs short-term memory and decision-making accuracy (Baygi et al.,2022).

Especially in tanker operations, fatigue related performance degradation is critical due to reliance on procedural adherence and awareness. Research shows that fatigued personnel are more likely to fail in procedures and misjudging risks and detecting abnormalities. These risks are diverted in environments with high administrative demands such as vetting preparations where cognitive resources are left out of operational tasks and implementation of documentation and compliance activities are laid as frameworks (Reason, 1997).

Stress factors arisen from inspection preparation, fear of negative vetting outcomes and job insecurity have been impacting crew morale and risk perception. Although the Maritime Labour Convention (MLC, 2006) regulates rest hours and welfare standards, real time data shows that formal compliance does not necessarily reflects to effective fatigue management. This contradiction underlines the structural limitation of prescriptive regulation and asks for dynamic assessment technique to examine how workload and psychosocial stressors are managed in real-life situations (Baygi et al., 2022).

2.2.3 Teamwork, Communication and Safety Culture

Effective teamwork is essential in environments where hazards can become fatal as well as strengthening bond between colleagues to ensure efficient operations. Tanker shipping is one of them and on tanker vessel, crews are frequently international which might cause linguistic and cultural barrier, and it can complicate operations and coordination (Aarskog et al., 2020). Misunderstandings due to cultural differences, ambiguous instructions and barriers regarding hierarchical structure on board have been pinpointed as primary contributors to unsafe situations (Hetherington et al., 2006).

Creating safety culture in shipping organization helps crew to conceive safe handling of equipment and overall safety perspective. A strong safety culture encourages crew to report any unexpected events, near misses and builds up collective responsibility for safe practices. On the other hand, compliance-based appliances of safety practices might not make crew feel engaged and they can be reporting without genuine feeling for it (Kim et al., 2016).

Organizational support is also crucial to reinforce safety culture. Crew tend to feel better if on shore-based management understands the needs and asks opinion of the crew in order to improve risk management system. Since the only good impact they can do is not forcing formal policies but also through allocation of resources, monitoring leaders' behavior and assessing communication channels to verify their quality. To be able to prevent lack of safety and ensure efficiency, organizations must relieve of commercial pressure of crew not to undermine safe operational practices (Panayides, 2019).

2.2.4 Implications for Safety Governance and Inspection Systems

Traditional inspections are primarily concerned with documentation and compliance with regulations. Thus, behavioral aspects and psychological risks tend to be neglected. Human factors are essential to implement more structural and solid inspection systems. Thus, effective safety management should include qualitative assessments which evaluate collaboration and decision-making factors in order to manage workload and stress factors (Aarskog et al., 2020).

Understanding this has increased awareness of human impact on safety ,and it has helped to create management systems that are not just for following rules but also for paying attention to human behavior and practices that support safety. Overall, the industry response indicates a dedication to making safety more practical and effective, emphasizing real-world practices over formal rules. (Flach, 2012).

2.3 Accidents, Risk, and the Evolution of Safety Governance

The tanker ships carry dangerous goods that might cause severe human, environmental and economic consequences. Crude oil, petroleum products, liquefied natural gases and chemicals are kind of cargoes that can multiply the possible damage of shipping related accidents. As a result, safety related improvements in tanker sector mostly derived from historical accidents and near-miss scenarios rather than proactive risk designs alone.

Regulatory frameworks and safety initiatives have been shaped by these occurrences over time (Aarskog et al., 2020).

Tanker shipping risk factors are combination of technical, operational, environmental and human related factors. Advancements in shipping technologies significantly reduced the likelihood of technical failures but accidents continue due to human related – interaction between human-technology and organization – factors. Consequently, risk assessment awareness shifted from solely focusing on technical compliance toward a broader understanding of systemic and organizational risk (Kim et al.,2016).

Major regulatory changes on tanker operations have led to the recognition of lacking traditional approaches and boosted implementation of new dynamic approaches in order to cover human factors and dynamic nature of operations, as well. Safety governance took made significant leap to include market-based mechanism, private evaluation and monitoring and behavioral assessments, aiming to influence operations beyond compliances (Bloor et al., 2013).

2.3.1 Major Tanker Accidents as Drivers of Change

Major tanker accidents were signals for regulatory bodies to take non-arguable decision to adjust maritime safety regulations. Systemic weaknesses in vessel design, operational procedures and organizational oversight were exposed as a result of catastrophic events such as grounding, major oil spills and explosions during the late twentieth century. These disastrous events have led regulatory bodies to make drastic changes, ultimately leading to introduce stricter international conventions and standards due to public, politic and commercial pressure (IMO, 2014).

After high-profile pollution incidents, MARPOL was introduced to establish comprehensive framework for pollution prevention and environmental protection. In similar way, International Safety Management (ISM) Code was a result of findings that accidents were often linked not only in technical failures but also inadequate procedures, poor management practices and weak safety culture (IMO, 2014). These regulatory frameworks increased the standards and expectations of safety management systems and practices of risk identification and continuous improvement.

Qualitative studies shows that these regulatory frameworks have been significant effect on mitigating the risks and thus reduction of accidents over time (Bloor et al., 2013). However, recent analysis shows reduction in accidents, safety performance improvements have been stagnant. This plateau has gained attention especially by oil majors and it is understood that existing regulatory and compliance-based approaches most probably exhausted their whole potential, opened up for new regulatory approaches to include human and organizational factors (Aarskog et al., 2013).

2.3.2 From Technical Failures to Organizational and Human Causes

Both internal and external factors are decisive in characterizing the tanker segment as exposed to operational hazards. Internal risks, such as flammability of cargo, toxicity; it is

mostly the gases cargo releases, cryogenic temperatures, particularly in LNG and chemical tankers, arise from properties of cargoes. Externally, as all vessels are exposed to navigational risks, especially in congested sea lanes, port entries and environmentally sensitive areas. Other factors, weather conditions, density of traffic and infrastructure of port areas increases risks thus, can cause to accidents if not managed properly (Kang et al.,2022).

Analysis of previous accidents on tankers show that incidents often caused by technical failures combined with human errors. Technological advancement contributed to reduction of accidents due to mechanical failures but the human-related errors, such as inadequate situational awareness, procedural deviations, miscommunication, remain as a fact. Outcomes of previous research evidently shows that tanker shipping is a high-risk environment not due to only technical aspects of it but also involvement of human factors such as, communication among crew members and organizational systems (Kim et al.,2016; Aarskog et al., 2020).

2.3.3 Accident Trends and Safety Performance Plateau

To a large extent, over the past few decades, technological development, improvement of structure, and improvement of policies governing regulation have contributed immensely towards a remarkable improvement in safety performance within tanker operations based on factors such as double hulling, improvement of navigation systems, and tough pollution control policies. These improvements have resulted in fewer major tanker accidents and significant environmental disasters, indicating a high level of technical maturity in safety in this industry (IMO, 2014).

In recent years there has been a growing body of literature showing how the implementation of safety management systems has resulted in significantly improved safety but also indicating how there has been a plateau in the ability to reduce accidents. This is referred to as a safety performance plateau, meaning that there is a point of diminishing return for compliance and technical based safety measures (Bloor et al., 2013; Aarskog et al., 2020). Over time, research has shown that many tanker operations' remaining safety risks stem from human/organizational aspects, such as fatigue, overload, lack of communication etc., rather than solely from technical faults (Kim et al., 2016).

As a result of the recognition of this plateau, we have seen a change in Safety Governance that had once focused solely on verifying compliance through formal records and documentation, to now, incorporating an assessment of how we perform our work through actual implementation. This shift provides human centered inspection methodologies, for example: SIRE 2.0, with the critical contextual foundation for addressing the safety issues that cannot be resolved through traditional regulatory means (Flach, 2012).

2.4 Regulatory Frameworks in Maritime and Tanker Shipping

Governance and regulation act as central pillar to shape safety practices, operations and organizational behavior within tanker industry. Multi-layered governance structure that includes international regulation, regional legislation and private industry-driven overseeing mechanisms are established in order to tackle challenges of high-risk nature of tanker operations which might cause severe consequences. Unlike other industries, tanker shipping is governed by a hybrid system in which oil majors and public authorities influence safety and operational standards as compound formation (Panayides, 2019; Bloor et al., 2013).

This multi-level governance is actually an indication of lacking comprehensiveness of traditional regulatory approaches to address complex safety operations. International conventions mostly rely on documentation-based compliance and prescriptive rules to set standards which may not fully capture essence of understanding daily operational safety. As a result, governance in tanker shipping has embraced movements that goes beyond formal regulations for commercial purposes, Improvement in inspection regimens and vetting systems are designed to manage risk factors in efficient way. Understanding the reasoning behind the introduction of SIRE 2.0 is crucial for assessing its effectiveness (Flach, 2012).

2.4.1 International Maritime Regulatory Frameworks

International Maritime Organization (IMO) is main governor of marine industry and conventions developed under it, which shape shipping. These conventions create solid foundation of tanker safety and environmental protection as well as legal backbone, establishing global standards for construction of vessels, operation and crew competence. Key instruments such as International Convention for the Prevention of Pollution from Ships (MARPOL), Safety of Life at Sea (SOLAS) and Standards of Training, Certification and Watchkeeping for Seafarers (STCW) directly impact on board operations by crew qualifications, navigation safety and pollution prevention-awareness (IMO, 2014).

In addition to these conventions, the International Safety Management (ISM) Code promotes of preparation and requirement of Safety Management System (SMS) across shipping industry. The ISM code mandates companies to identify operational risks, establish procedures, report near-misses and develop continuous improvement processes so that safety management plans will not be treated as side quests (IMO, 2014). These regulatory instruments have huge impact on improvements over tanker safety. However, many scholars argue that their effectiveness heavily relies on actual practices and interactions with organizational culture and human actions (Aarskog et al., 2020).

2.4.2 Labour Regulation and Crew Welfare: MLC 2006

Labour regulation is critical component in regard of mental health, fatigue management and general crew welfare. The Maritime Labour Convention (MLC) sets minimum standards for living quarters, work and rest hours, medical care, repatriation and social protection. Aim of the MLC is to protect wellbeing of seafarers while supporting fair competition among shipping companies by establishing a regulatory foundation (MLC, 2006).

Introduction of MLC certainly improved overall working conditions, but research indicates that stress, fatigue and mental health issues continue to challenge maritime professionals, especially in high-risk tanker shipping (Baygi et al., 2022). Overtime hours, frequent inspections, meticulous documentation requirements, and demanding working environment contribute to cumulative fatigue and overall reduced well-being. Studies underline that labour regulations do not capture real-life experiences of seafarers. This gap between regulations and real-life scenarios highlight the need of examining of how regulatory frameworks associated with human factors in practice (Gander et al., 2017).

2.4.3 Tanker-Specific Regulatory Requirements

Aside from internation conventions, environmental requirements are expected to fulfill by tankers to provide transparency and corporate accountability. In Europe, EU Emissions Trading System (EU ETS), FuelEU Maritime, and improved port state control under the Paris Memorandum of Understanding (MoU) have increased expectations of sustainable operations on tanker shipping (Andersson et al., 2016). These measures forced shipowners to comply with new regulations in European waters.

At the same time, cargo owners and charterers request higher operational standards than those required by regulations. In particular, oil majors impose stringent conditions on chartering vessels to ensure safe transportation (Bloor et al., 2013). Compliance with regulations and expectations is not optional but a prerequisite to access the commercial market.

2.4.4 Regulatory Compliance and Operational Reality

The complex environment of tanker shipping has shown that merely complying with regulations is not adequate to assure safe and efficient operations. In recent years, scholars have been arguing that compliance-based governance cannot capture the risk that is brought by dynamic shipping environment thus performance and risk-oriented approaches must be embraced. In practice, this means moving beyond audits and examine how real operations are conducted (Flach, 2012).

This ongoing shift have huge impact on administrative part of shipping companies since implications of regulatory compliance, commercial expectations and operational realities defines their policy approach. Governance beyond compliance requires companies to invest in safety training and communication to develop safety culture to enhance social sustainability. It can increase administrative demands and create contradiction between safety objectives and efficiency goals for small shipping companies (Panayides, 2019). In this evolving governance of tanker shipping, understanding of inspections and vetting systems as attempts to go beyond compliances by integrating human factors into safety is crucial to examine how such system function and their effectiveness.

2.5 Commercial Vetting and Market-Based Safety Control

Commercial vetting schemes also demonstrate a unique approach to tanker shipping governance that operates in conjunction with global regulation and flag state control. The

driving force of commercial vetting is cargo owners, in particular oil companies, looking to mitigate risks associated with tanker shipments. What differentiates commercial vetting from regulation, the latter of which stipulates minimum standards, is the application of pressure through market forces, as a ship is deemed acceptable for hire or not (Bloor et al., 2013; Panayides, 2019).

Consequently, the safety governance practice in the tanker shipping sector cannot merely be explained by a formal legal approach. Instead, the reality is that it operates within a hybrid regulatory environment that recognizes the enforceable role of private bodies in applying safety standards that go beyond the norm. In this case, the vetting process operates within the domain of safety regulators, who link success or failure to safety and financial performance.

2.5.1 The Role of Cargo Owners in Safety Governance

The cargo owners remain prominent actors in determining tanker shipping safety governance because of their influence associated with chartering operational standards. The oil majors continue to face potential significant financial and reputation damage associated with tanker accidents and pollution. The oil majors have thus developed self-testing systems to assess the tanker owners and operators with whom they interact as opposed to relying on regulatory requirements for compliance (Bloor et al., 2013).

This reflects an overall move towards the privatized regulation of high-risk sectors, whereby the market plays a role in regulation generally carried out by the state. By creating their own standards of safety and modes of inspection, cargo owners effectively establish industry standards, setting the tone for management operations, crew, and priorities within ship operating firms (Panayides, 2019). What this means, of course, is that adherence to global conventions is necessary but not a determinative factor for labor market entry within the tanker industry.

2.5.2 Vetting as a Market Access and Risk Management Tool

In addition to the regulatory compliances, the tanker shipping industry implemented vetting systems to ensure safety and quality standards as complimentary. Vetting acts as a market-based risk management tool for cargo owners-oil majors to assess the reliability of vessels and operators for chartering. Unlike statutory inspections, result of vetting inspections determines whether vessel is suitable for employment since it affects commercial employment directly, thereby puts a lot of stress on shipowners and managers (Bloor et al., 2013).

Commercial and reputational risk for cargo owners that can occur is to be rectified by vetting systems to prevent possible accidents thus, safety performance step over the line of regulatory compliance and becomes commercial necessity. Previous research underlines that to be able to compete in the market, just complying with regulatory requirements Is not sufficient but setting higher standards is a must (Panayides, 2019).

This approach reshaped organizational goals and priorities within tanker shipping companies. Allocated resources for inspection preparedness, documentation, crew training and

procedural standardization was not scarce to ensure positive outcomes out of vetting. While vetting has contributed to high safety standards it increased administrative workloads and operational pressures. This situation has created financial burden particularly for smaller organizations with limited resources (Bloor et al.,2013).

2.5.3 The Original SIRE Programme

In 1993, The Ship Inspection Report Programme (SIRE) was developed by the Oil Companies International Marine Forum (OCIMF). SIRE is one of the most influential development vetting systems in tanker shipping. Sire was introduced in order to standardize tanker inspections and relay trustworthy information among oil companies, thus it facilitates transparency and reducing duplication of inspections across the industry (OCIMF, 2022).

Original SIRE framework was using standardized checklists to assess technical capabilities, equipment compliance and procedural adherence. Outcomes of the inspection reports were uploaded to a centralized database for members of the OCIMF. System helps charterers to make informed decisions based on recent inspections. This system increased consistency and contributed to the professionalization of tanker shipping monitoring (Bloor et al., 2013).

Despite its achievements, the original SIRE was old-fashioned and mostly compliance oriented. Inspections were focusing on whether the documentation procedures and physical conditions were meeting the predefined requirements which was limited to oversee operations on paper rather than actual actions. As a result, the program was effective in assessing technical deficiencies but less capable of covering behavioral acts , organizational and psychological dimensions of safety performance (Aarskog et al., 2020).

2.5.4 Strength and Limitations of Traditional Vetting

Traditional vetting systems such as SIRE program had a critical role to ensure improvements safety standards across the tanker vessels. Ensuring standardization, transparency was its strong card to influence market availability of vessels. By linking inspection outcomes affects the chartering practices which was forcing shipping companies to ensure compliance and enhancing their standards to stay relevant (Bloor et al., 2013).

However, several studies shows that traditional vetting approaches have its limitations. First, focusing on checklists, tend to prioritize observable conditions and ineffective to measure human-related risks. It is harder to pinpoint latent organizational weaknesses. Second, focusing on documentation related safety can lead to only-compliance mindset rather than making effort to apply actual safety practices to ensure operational safety (Kim et al., 2016). Furthermore, traditional vetting caused increased workload and stress for crew due to extensive preparation. Previous research indicates that such pressures made negative impacts on well-being overall, crew was exposed to fatigue which leads to poor decision-making, linked to accident risk (Baygi et al., 2022; Aarskog et al., 2020).
These limitations increased the awareness that safety is not a measure which is compiled to ensure only on paper but also it must evolve to be more effective. This recognition has led to introduction of SIRE 2.0 which seeks to address lack of human impacts on traditional vetting practices and explore effects of human centered behavioral on real time operations (Aarskog et al., 2020; OCIMF, 2022).

2.6 SIRE 2.0: Evolution Toward Human-Centered Inspection

Introduction of SIRE 2.0 has transformed philosophy of tanker vetting by emphasizing importance of human factors. SIRE was able to set comprehensive standards that covers almost all aspects of safety but its compliance driven structure proved insufficiency to address complex human and organizational factors (Aarskog et al.,2020). SIRE 2.0 illuminated the path that was built up by first version of SIRE, seeking for edges which was covered and actually causing problems in practice. Overseeing the actual safety practices that was shaped by human behavior, amount of workload, quality of communication and support of shore-based management to assess its validity (Flach, 2012). Acknowledgement of SIRE 2.0 as an institutional response to the recognition that improving safety performance requires comprehensive control mechanism over actual operations onboard tankers.

2.6.1 Rationale Behind the Introduction of SIRE 2.0

The development of Sire 2.0 was made possible by a number of interconnected catalysts. The first catalyst was that the frequency of large scale and catastrophic accidents has seen a significant reduction in previous years, however the overall safety performance has stagnated and is seeking a means to improve (Aarskog et al., 2020). Research into the contributing factors of this perturbation revealed that the most significant contributors were fatigue, miss-communication, and drift from procedures which resulted from human error. The second catalyst was that traditional vetting methods rely on adherence to regulations rather than an accurate representation of actual operations. The preparation of documentation and tracking of the ongoing inspections could be regarded as "Paper Safety" purely due to the way it is being approached by academics. Procedures were originally conceived to satisfy the inspectors not to create safety standards (Kim et al., 2016). Due to this approach, many inspectors are misled as they only see numerous forms of impeccable documentation while they evaluated the entire operation as being conducted in an acceptable fashion. The third catalyst was a true representation of the measurement of the operational risk via a reliable system to provide the charterers and cargo owners with accurate information. The oil majors have established the requirement to adhere to a more in-depth level of inspection prior to making any decisions on the evaluation not only of the equipment but also of the crew's competence and their company's safety culture. The SIRE 2.0 system has been established to enhance decision making by incorporating into the vetting process both the operational risk factors and human factors associated with the operation.

2.6.2 Inspection Philosophy and Structural Changes

Implementation and application of SIRE 2.0 is fundamentally different than previous version of SIRE. Rather than asking same questions to each vessel relying on static checklists, new system empower dynamism to evaluate real time scenarios where inspector select questions

based on type of vessel, cargo, charter and operational context (OCIMF, 2022). This approach is a clear indication of previous SIRE since applying same template on each scenario or situation cannot be adequate to assess each risk. SIRE 2.0 s structure include digital platform , evidence-based observations such as photograph taken by crew to be inspected to ensure discretion. This allows inspectors to make better evaluations to verify operational records and crew demonstrations. This helps system to refrain from repetitive and superficial and increases the focus on how system function in real life. Another important aspect is the shift from vessel-centric assessment to system level evaluation. SIRE 2.0 does not cover only ship operations but also oversees the integration of shore management.This is to validate involvement of the whole organization.This is a statement that underlines the importance and inseparability of onboard performance from organizational context (Flach, 2012; Panayides, 2019).

2.6.3 Behavioral and Psychosocial Assessment in SIRE 2.0

SIRE 2.0's clear vision on behavioral and psychosocial aspects of operational safety is one of its distinctive features. Inspectors are willing to assess whether crew members can respond to abnormal situations which creates stress factors, communicate and collaborate seamlessly under pressure to ensure safe operations. Also managing workload under time pressure to comply with work-rest hours. These assessments surpassed the procedural knowledge to examine competence such as awareness, decision-making to verify demonstrated performance under realistic scenarios (OCIMF,2022).

As well as situational awareness and decision making, teamwork and leadership dimensions are also evaluated under SIRE 2.0. For example, major main engine overhauls can be observed to see how the engine crew interacts under demanding conditions or during cargo operations the deck crew's involvement with operations heaving/slacking of winches or situation with ballast operation – chief officer and carpenter – all these operations are conducted under time and situational pressure. Previous study shows that critical decisions that might impact safety are shaped by cognitive load, stress and team interaction rather than theoretical knowledge alone (Kim et al., 2016).

Fatigue management and workload distribution are also embedded within inspection process. SIRE 2.0 was introduced to acknowledge psychosocial risk factors in shaping safety outcomes and seeks to discover the methods to mitigate risk by examining watch schedules, rest hour compliance and task allocation. These aspects of the SIRE 2.0 is the most significant difference from the traditional vetting, which magnifies human-related actions and focusing on well-being as a regulatory compliance issue rather than technical aspects of the operations onboard vessels (Baygi et al.,2022).

2.6.4 Organizational and Operational Implications

Implementation of SIRE 2.0 will have a substantial effect on the crews on board, as well as the management and shore-based organizations with which they interact, through an operational perspective; crews must also develop an understanding of how to adapt and work as a team effectively (which may lead to questions about crewmates); therefore, crews will likely be persistently concerned while they are working. In addition, it is not only to prepare crews for forthcoming inspections, but also to enable crews continually to carry out safe operations (Hetherington et al., 2006).

It will be incumbent upon organizations involved in providing shipping services to expending appropriate financial resources to develop comprehensive crew training systems that promote desired behaviors and encourage positive psychological well-being. These systems must also enhance crew members' understanding of how to maintain sustainable long-term practices. Establishing a training framework that allows crew members to develop the necessary qualifications for continuous improvement and creating a structure in the organization that verify their progress is also essential. This process will help ensure that crew members receive realistic training instead of relying purely on written documentation, as this will help to prevent marine accidents and to build a positive safety culture within the organization, while also creating significant challenges for management, particularly for smaller organizations, as they will be required to invest considerable time and resources to implement these changes (Flin et al., 2000).

From a managerial standpoint, SIRE 2.0 focuses on how human and commercial benefits are related to each other when assessing the commercial value of safety performance. The results from these inspections offer valuable information about how a business operates. It analyses the organization's culture, effectiveness of training programs and management of psychosocial risks, creating a direct link between outside parties and the organisation. It gives proof to cargo owner(s) regarding the level of ship management a company demonstrates. Additionally, it indicates to all parties involved whether adequate overall safety measures are taken as well as balanced management practices such as concern for the psychological welfare of crew members. The main goal of SIRE 2.0 is to continue to be flexible and to maintain this balance (Flach, 2012).

2.7 SIRE 2.0, Safety and Efficiency

Traditionally, the tanker sector has maintained stringent safety requirements. Management of safety practices is regularly updated based on the experiences of previous incidents. In addition to requiring a safe manner of operation, the high-value nature of the product being delivered demands that operational efficiencies be achieved. The introduction of SIRE 2.0 has changed the way the dual focus placed on both operational efficiencies and safe

operation within the tanker industry is viewed. The previous emphasis on attaining commercial gains often associated with technical operations has been modified by placing more emphasis on the human component of working in a tanker. The transition from using the traditional vetting process of vetting paperwork and procedures to using a holistic approach to vetting using SIRE 2.0 includes placing more emphasis on workload and routines and on evaluating more complex relationships (Bloor et al.,2013).

Also, previous research indicates that the traditional processes of vetting a vessel (referring to the process of verifying the qualifications of crew members) and the first version of SIRE decreased vessel accidents to some extent. However, the reduction in vessel accidents reached a threshold where the number of accidents plateaued; thus, improvements were necessary to the existing wrecking process. SIRE 2.0 was developed in response to the need for greater development beyond just meeting regulatory requirements; it leverages existing practices and utilizes the ability to adapt to a continually changing environment as a means of enhancing operational procedures. Oil tanker operators have already started using the new system for these reasons. However, the added stress/pressure on ship crew members and offshore/operators is creating more tensions between ship crew members and ship operators (Aarskog et al. 2020).

2.7.1 Safety Performance and Human Factors

Over the years, the primary factors as to why tanker accidents occur has changed. Prior to the 1990s, tanker accidents were typically the result of design deficiencies and technical malfunctions. With advances in technology and the improvement in safety systems aboard ships it is now rare for new types of design and technical issues to be the cause of a tanker accident (Hetherington et al., 2006). As a matter of fact, by adopting double-hulled ships and improving navigation and automated systems aboard ships, it has improved the entire safety system and led to significant decreases in fatalities resulting from tanker accidents. Thus, because of these new safety advancements, when examining why tanker accidents occur, the focus is on human behavior instead of concern for technology (Kim et al.,2016).

The human factor is more than just a product of mistakes made by individuals. It also includes other elements that affect how individuals perform, such as situational awareness, effective communications, ability to make decisions in a crisis, organizational stresses and types of safety cultures that exist. Based on earlier studies, technical issues are minimally involved in the majority of tanker accident occurrences compared to human factors, and most "near misses" are a product of the type of behavior of humans in the work environment and how they are organized (Aarskog et al.,2020).SIRE 2.0 was implemented precisely for this reason. The questionnaires within SIRE 2.0 do not merely assess the awareness of the crew members. It is more about examining how procedures are applied in real-life situations. For example, they analyze how information is transferred between officers during shift changes, how a crew member might respond in the event of a fire, or how the deck crew communicates during high-risk cargo transfers, offering valid feedback. This approach allows for the

consideration of tanker operations, which are a socio-technical environment, within a theoretical framework (Flach, 2012).

However, it is also possible that a focus on security issues may cause neglect of the broader systemic and organizational failings. Future SIRE 2.0 improvements will be more effective by moving away from focusing exclusively on the individual error/blame approach and emphasizing the total analysis of errors to create clear, comprehensive knowledge regarding the organization's entire system (Bloor et al., 2013).

2.7.2 Administrative Burden and Operational Efficiency

With the release of SIRE 2.0, there has been a growth in numbers due to the combination of additional in-depth assessments that include human factors. Psychological and technical conditions have expanded commissioned contractor(s) access to greater volumes of data and subsequently will increase preparing degrees and inspections by Companies to meet these requirements. As a result, tanker operators especially smaller companies with limited resources, are feeling overwhelmed by the new demands of meeting their operational needs. Tanker vessels, operate in an environment already burdened by extensive oversight, risk/pressure from external forces such as MARPOL, SOLAS, ISM, MLC, International and Regional Regulations, Documentation, and Reporting associated with these requirements. The introduction of Human Factors into this equation increases the burden of compliance for Tanker Operators and all Supporting Companies, ultimately increasing the exit cost of achieving safety and compliance (Panayides, 2019).

Studies indicate that there is an intensified load placed upon the crew by the administrative functions that increased levels of stress place the crews at an increased risk for unsafe practices. The documentation and procedures are viewed from multiple perspectives (Baygi et al., 2022) and also affect the relationships between land and marine management as well as between crews and land-based personnel, in that there is fatigue and increased stress on all personnel due to the new procedures of SIRE 2.0.

Now, there is a paradox: a program created to enhance safety operations and to improve health benefits for the crew, could lead to increased strain on the personnel performing those operations. The current literature indicates that there is not a direct linear correlation between administrative strain and safety performance; thus, the effect of SIRE 2.0 should not be evaluated just by the increase in safety protocols but by how these protocols are implemented.

2.7.3 Balancing Safety, Well-being, and Business Performance

A large number of publications are reporting a steady rise in the number of companies implementing Security, Welfare and Employee Wellness (SIRE) -increasing focus on

balancing security, employee welfare and performance. Historically, supplementary measures were seen solely as a financial burden and, as a result, fettered operational performance. Recent studies confirm this belief - demonstrating that not only do security and welfare positively contribute to operational performance, but they significantly enhance overall operational efficiency (Baygi et al., 2022).

In the case of an employee traveling in a high-hazard vehicle within an extremely hazardous environment, combined with no opportunity for rest and time away from friends and family, the stresses imposed on employees can have a negative impact on their ability to operate within that vehicle. SIRE 2.0's purpose is to identify the effects of these stresses on the capacity to achieve operational excellence; to evaluate how these stresses lead to vehicle accidents from the point of view of an employee's performance; and to identify methods for protecting against this type of incident occurring. In order to ensure the success of SIRE 2.0, proper management of employee stressors is of the utmost importance, as inadequate management will increase the stress on employees at sea, as well as on employees working away from home base. Organizations that invest in their employees' health and wellness achieve better long-term commercial success. The elimination of safety issues not only lowers direct costs but also lowers indirect costs such as loss of business reputation, interruptions in operations and increased insurance costs. This suggests that the successful management of SIRE 2.0 provides both operational benefits for the crew and the company as well as financial benefits to both companies involved (Bloor et al, 2013).

The effectiveness of SIRE 2.0 will not be evaluated based solely on an increase in safety, but also through a comprehensive view of both human well-being and workforce productivity. If this is not done, the results will likely be twice as negative, as the only results would be an increase in the demand on the system and an increase in the workload (Panayides, 2019).

3. Method

This chapter outlines the research strategy adopted to address the research problem of this thesis. It explains the research design, data collection methods, and data analysis process. The research design uses both an abductive and an exploratory approach, as well as a qualitative case study strategy. This allows for a thorough examination of the impact of SIRE 2.0 on workload, work environment, and operational efficiency, while also considering the influence of human factors on these results.

3.1 Research Design

This study will be handled through a qualitative research design by an abductive research approach to explore the effects of SIRE 2.0 implementation on crew workload, work environment, and operational practices on tanker vessels (Dubois & Gadde, 2002). The aim of the research is to understand how the implementation of SIRE 2.0 affects workload, work environment, and operational practices, and to capture how the maritime professionals apprehend the system, which is the reason for the use of qualitative research (Creswell, 2013). An abductive approach was chosen because it facilitates a dynamic interplay between empirical data and theoretical concepts (Timmermans & Tavory, 2012). This is especially important for this study because SIRE 2.0 is a relatively new inspection framework, and its real-world effects—especially on human factors and workload—are still being figured out. This method involved constantly comparing existing theories about work environment, workload, human factors, safety culture, and change management with what was learned from the interviews.

Since ‘why’ and ‘how’ crew members are influenced by SIRE 2.0 is under scope, exploratory research becomes natural to examine the effects of inspections. Exploratory research is appropriate for examining not fully comprehended phenomena, particularly those related to human perceptions and organizational behavior (Saunders et al., 2009). In this context, SIRE 2.0 is seen as a new development in the industry that changes the way inspections are done by moving away from checklists and toward a system that focuses on people and uses evidence. A single case study design was used to investigate this phenomenon.

Case studies are especially useful for examining real-life situations where the context is important (Yin, 2009). The aim of this thesis is to analyze SIRE 2.0 in the context of tanker operations highlighting the interconnections among regulations, organizational processes and crew interactions. The case study method enables a comprehensive understanding of the experiences of various stakeholders regarding the new inspection philosophy.

Furthermore, the research design employs a multi-perspective approach by incorporating participants from the onboard crew, onshore personnel, and industry representatives. This allows the study to see how SIRE 2.0 is seen and used at different levels of the ship

management system. This approach is in line with human factors and socio-technical perspectives and indicates that safety and performance are affected by how people, processes, and organizational structures work together (Carayon, 2006).

3.1.1 Theoretical Framework

The theoretical framework of the study was established by exploring peer-reviewed articles and official pages related to maritime business, such as the IMO webpage , concentrating on human factors, safety culture, risk management, and inspection systems. The secondary data was collected through searches in academic databases, Google Scholar, Scopus and using keywords related to SIRE 2.0, tanker inspections, human factors, safety culture, workload, psychosocial work environment, and maritime safety. These concepts facilitated to compile questions and deciding of interview scheme. Empirical findings were compared with theoretical insights to enhance the analytical framework.

3.2 Data Collection

The data for this study were collected by using semi-structured interviews to understand the experiences and perceptions of people involved in SIRE 2.0 inspections. This approach was chosen because it allows participants to share their views in their own words while ensuring that the research questions are still addressed effectively (Kvale & Brinkmann, 2009).

Subjectivity on experiences such as workload, working environment, and human factors is decided to conduct semi-structured interviews to capture feelings which cannot be indicated by numbers. Thus, a flexible approach is more effective to follow up with deeper questions to understand the interviewee's thoughts, which is crucial (Creswell, 2013).

3.2.1 Selection of participants

Selection of participants were made by using purposive sampling strategy to target individuals with direct connection to SIRE 2.0 (Creswell, 2013). Sample includes on board crew – such as officers and ratings – as well as shore-based personnel and professionals in the body of the regulatory associations. This selection was made to capture different perspectives on how SIRE 2.0 is experienced across the industry.

Initially, participants were contacted through professional networks and email. In addition to purposive sampling, snowballing was also applied to reach out to acquaintances- other officers etc.- of the initial participants who had practical experience with SIRE 2.0 (Noy, C. (2008). Then these additional participants were contacted via email and invited to participate in the study.

3.2.2 Conducting Interviews

The interview questions were prepared in order to conceive how SIRE 2.0 influences workload, operational efficiency, working conditions, work environment and human factors on tanker vessels. Since the interviews are conducted as a semi-structured way, questions were organized around thematic analysis rather than only strictly fixed questions (ref semi-structured interviews). Later thematic analysis categories were created for reflection: adaptation to the new inspection regime, predictability and structure, realism and alignment with operational practice, impaired work environment, and improved work environment. Also themes included sub-categories related to adaptability, clarity, pressure and stress, resilience, fatigue, communication, continuous learning, and safety culture.

A set of general questions was asked to all participants in relation to the identified themes, particularly focusing on experiences of adaptation, workload, predictability, communication, and safety culture under SIRE 2.0. Additional questions were selected based on the participants' operational role and involvement during the interview process. In order to encourage participants to describe their overall experience with SIRE 2.0 , flexibility throughout the interview was provided. This flexibility enabled participants to elaborate on issues they considered important and capture more detail about how they work with the system.

3.3 Data Analysis

The interview data were analyzed using a thematic analysis approach, following the framework developed by (Braun & Clarke, 2006). All Interviews were transcribed word for word and reviewed several times to ensure clarity and understanding of the data. During this process, initial codes were created by finding important patterns in participants' responses, especially concerning their experiences with SIRE 2.0.

Firstly, in order to get familiar with the data, interview transcripts were reviewed multiple times. As the transcripts were reviewed, some initial patterns and recurring concepts started becoming clear. Apart from the expected topics based on the interview guide, other emerging issues included workload, work environment, and human factors. These emerging topics were taken into account during the subsequent interviews, such that the research process could be iterative in nature based on an abductive approach.

In the second step, recurring expression related to participants' experiences were identified and coded then these codes were organized into broader thematic categories. These codes were then grouped and refined into broader themes that reflect the main focus of the study. Themes such as workload, work environment, human factors, and operational efficiency were highlighted in connection with the research questions. The analysis also stayed open to new patterns that were not clearly expected during the initial design of the interview questions.

This method allowed for both a structured and data-driven identification of themes across different roles of participants on the board.

By using thematic analysis, transcripts were analyzed. This involved by grasping the deep meaning of what actually participants were saying and comparing the perspectives across to find out both similarities and differences in SIRE 2.0 experience. Identified themes were supported by quotations from recordings to reflect the participants' real experiences and feelings on SIRE 2.0. Some of the recordings were slightly edited in order to prevent any misunderstanding. The data collection stopped due to saturation. Interviews continued until similar responses and patterns began to repeat across participants which is a indication of certain level of depth had been reached (Braun & Clarke, 2006; Willig, 2022).

Finally, to connect empirical data to existing literature and strengthen the validity of the analysis the themes were interpreted according to a theoretical framework which allows a more comprehensive understanding of how SIRE 2.0 impacts daily operations (Nowell et al., 2017; Fusch et al., 2018).

3.4 Ethics

The research process was conducted according to ethical considerations. The purpose of the study was explained to them, and their involvement was entirely voluntary. Prior to interviews, participants were informed that their identities would be kept anonymous and all data collected would be handled confidentially in accordance with GDPR regulations. The recordings and the transcripts were used only for academic purposes and they had right to withdraw from the study without any reason. Usage of quotations in the study was kept anonymous and attributed to professional roles rather than individuals to maintain confidentiality.

4. Results

This chapter presents the findings from semi-structured interviews with participants. The results were analyzed by using thematic analysis and divided into five main themes with several sub-themes reflecting different perspectives of participants (see Table 1). The themes focus on adaptation, predictability, realism, impaired work environment and improved work environment to investigate impacts of SIRE 2.0 on workload, work efficiency, working conditions, work environment and human factors on tanker vessels.

Table 1 : Themes

Categories	Sub-categories	Work Environment	Work Efficiency	Workload	Working Conditions	Human Factors
Adaptation		x	x	x	x	x
	Adjustment to a New Inspection Paradigm (Adaptability)	x	x	x	x	x
	Continuous Learning and Skill Development (Growth)	x	x	x	x	x
	Coping with Changing Operational Expectations (Resilience)	x		x	x	x
Predictability		x	x		x	x
	Perceived Structure and Standardization (Order)	x	x		x	
	Clarity and Transparency of Expectations (Clarity)	x	x		x	x
	Sense of Reduced Uncertainty (Certainty)	x			x	x

Realism		x	x		x	x
	Perceived Alignment with Real Operations (Authenticity)	x	x		x	x
	Practical and Contextual Relevance (Relevance)	x	x		x	x
	Credibility of Evidence-Based Assessments (Trust)	x			x	x
Impaired Work Environment		x	x	x	x	x
	Perceived Increase in Administrative Burden (Overload)	x	x	x	x	
	Experience of Time Pressure and Work Intensification (Pressure)		x	x	x	x
	Mental and Physical Strain (Stress & Fatigue) (Exhaustion)			x	x	x
	Confusion and Ambiguity in Requirements (Uncertainty)	x			x	x
Improved Work Environment		x	x		x	x
	Increased Awareness and Safety Mindset (Awareness)	x				x

	Perceived Improvement in Communicatio n (Clarity)	x			x	x
	Opportunities for Learning and Development (Development)	x	x			x
	Strengthening of Safety Culture and Practices (Safety)	x			x	x

The perception of SIRE 2.0 is generally positive within tanker industry, especially in terms of transparency and consistency of inspections and alignment with real working practices. Participants frequently described that new regime is more structured and operationally realistic compared to previous inspection systems. But also, increased administrative burden and time pressure create extra challenges for them.

Almost all participants emphasized the improvement in safety culture by the centralization of human factors that the SIRE 2.0 introduced. But there is a contradiction in the system, standardizing enhanced the impact of the overall inspection process, yet it still varies depending on the inspectors. Implementing more structured framework to improve procedural approach supported operations but it contributed to higher workload and pressure for maritime professionals.

Overall, the findings suggest that SIRE 2.0 not only affects technical and procedural changes but also communication, real working conditions and decision-making mechanisms. The following sections present the results under each thematic category identified during the analysis.

4.1 Adapting to Changing Inspection Dynamics

The results in this study show that the introduction of SIRE 2.0 has changed how people think about and handle inspections on tanker ships. Inspections are no longer separate events that are only done when there is a checklist. Instead, they are now part of daily operations and are affected by how people interact with each other, how well they know the procedures, and how the situation changes. Adaptation is thus a continuous and multi-faceted process rather than a singular adjustment.

The participants' experiences indicate that adapting to SIRE 2.0 means not only changing how they prepare for work, but also how they organize their work, use their knowledge, and deal with uncertainty. The system sets up a more organized and clear framework, but it also needs to be flexible and responsive because inspections are dynamic in nature. This creates a work environment where stability and change happen at the same time, so crew members have to constantly find a balance between following procedures and meeting operational needs in real time.

4.1.1 Shifts in Preparation and Operational Readiness

SIRE 2.0 has significant impact on how crew members do their daily tasks and inspection preparations. Instead of quick fixes before the inspections, they are encouraged to perform their daily work according to procedures and provide continuous readiness.

“Preparation is different now: it’s more about checking SMS updates and knowing procedures rather than just hardware.”

This leads to a shift toward a more knowledge-based approach, where familiarization with the procedures becomes the most important part of operational readiness. Crew members are now expected to keep their operational knowledge up to date with procedures and system requirements at all times, instead of just focusing on technical checks before inspections. This means that inspections are becoming more of a part of everyday work rather than being seen as separate events.

At the same time, participants emphasize that this ongoing preparedness does not make inspection processes easier.

“If we follow our SMS, then we are basically ready all the time, but of course, when it comes to inspection, we step up a little bit more.”

This indicates that adaptation means maintaining some level of readiness for anything while still being able to handle the extra stress of inspection situations. The system supports preparation, but the crew is still responsible for handling workload and performance while under inspection.

4.1.2 Continuous Learning and Procedural Awareness

Another important aspect of adaptation lies in the growing proceduralization of working routines and its influence on the performance indicators and decision-making processes of the crew members in order to comply with safety procedures. According to the participants, the process of proceduralization occurs not only during the inspection but also in their everyday practices.

"You need to have a procedure for almost everything you do on board… and if it does not exist then you need to contact the office and create one."

In addition, participants emphasize a need for attentiveness and verification which is required from crew members.

"We double check more before the vetting and we are a little bit more careful, but otherwise it feels quite similar to before."

This suggests that while overall tasks remain unchanged, the methodology of tasks to be executed has changed. Increased focus on verifying and procedural compliance demonstrates a more cautious and controlled approach to tasks.

All in all, SIRE 2.0 promotes a more knowledge-driven and reflective working environment, according to these findings. Crew members' continuous engagement with procedures creates an environment that provides ongoing learning to help them refine their understanding of the requirements for operation on board.

4.1.3 Responding to Variability and Inspection Uncertainty

Despite the structural guidelines introduced by SIRE 2.0, almost all participants wanted to emphasize that inspections had unpredictability due to the role of the inspectors and situational factors.

"Even though the system is more structured, sometimes the inspector will go into deeper questions… we need to quickly adjust our priorities."

This shows the situational aspect of adaptation. Standardization provided by a framework does not fully capture how it is conducted in practice. In order to keep up with demanding inspection processes crew members must remain resilient and be capable of reprioritizing tasks to prevent any unexpected operational outcomes.

A similar perspective is reflected in how participants describe the variability of inspection processes.

"We generally know what to expect, but the way the inspection develops can still change depending on the inspector."

One of the reason for introducing SIRE 2.0 was to increase the objectivity of inspections. But participants still emphasize that inspection experience may vary depending on the inspector.

Overall, variability in inspections requires operational resilience. Crew members, must be prepared to deal with unexpected occurrences while also showing good level of involvement with expected demands.

4.2 From Uncertainty to Structure: The Role of Predictability

Another reason for releasing SIRE 2.0 was to make a transition to a more structured and predictable inspection framework. Unlike previous inspections that includes more subjective insight from inspector perspective. Relatively new system SIRE 2.0 is trying to build-up more consistent inspection model across the vessels.

However, predictability should not be understood as complete uniformity in this context, it shows system's ability to provide structural framework to conduct inspections in stable way. Participants' emphasize that SIRE 2.0 increase predictability through transparency and coordination while still varies due to human factors.

4.2.1 Formalization of Structure and Inspection Flow

Structural changes introduced by SIRE 2.0 improved predictability of inspection processes. Even if the context of the inspections did not see any changes, participants mention that inspections are more organized and this change reduces the randomness of inspection processes.

"The inspection is more organized now, and from an operational point of view it feels more or less the same, but the structure makes it easier to follow."

This shows that predictability comes not from changing the main operations but from organizing how those operations are assessed. The system offers a clearer structure that directs the order and reasoning of inspections, making the process easier to navigate.

In addition, participants suggest that pre-planning contributes to a more manageable and stable inspection flow.

"Inspections are now planned during the opening meeting… taking into account workload and rest hours."

This quote suggests that integrating inspection processes by taking daily operations into account helps to perceive limits in planning and matching inspection flow with actual working conditions which minimize disruptions and creates a more controlled process.

4.2.2 Transparency and Pre-Defined Expectation

SIRE 2.0 sets inspection expectations clearer by providing predictability and participants state that SIRE 2.0 presents better visibility, documentation and evaluation criteria.

"Inspector already has photographs, certificates… that saves a lot of time."

This shows how access to information before inspections changes their nature. Instead of depending on findings during the inspection, the process focuses more on verification.

"Before we knew which inspector would ask what, but now we need to be broader because we cannot predict the questions anymore."

SIRE 2.0 prepares crew members to understand the logic of the system and the flow of the inspection processes rather than predicting specific questions.

4.2.3 Limits of Predictability within a Structured System

Despite the structural improvements, several participants state that inspectors' approach to the process might add complications. Instead of removing uncertainty, inspections can be challenging due to the perception of inspectors.

"Even though the system is more structured, the overall experience can still vary depending on the inspector and the operator involved."

This shows that differences still exist in how things are carried out. The system outlines how inspections should happen, but it cannot completely control how people understand or use these guidelines.

Another limitation emerges in relation to post-inspection processes.

"Since we need to fix all the observations within a time limit, it becomes more work after the inspection."

This suggests that predictability in the inspection phase may move uncertainty to later stages, especially in how observations are handled and managed. The system sets clearer expectations but also brings new kinds of pressure and variation in follow-up actions.

4.3 Alignment with Operational Reality: Realism in SIRE 2.0

The main purpose of the introduction of the SIRE 2.0 was to align inspections with actual operational practices on board. The system underlines the importance of real-life situations to be inspected by this regime rather than compliance-type checklist verification. As a result, inspections are perceived as part of operational routines, not as isolated external assessment.

4.3.1 Perceived Alignment with Real Operations

According to participants, new inspections under SIRE 2.0 capture the realistic scenarios onboard compared to previous systems. This indicates that the inspection process is no longer detached from daily work.

"For us on board I would say it is more or less the same, but for the office they do a lot more now since they are writing the procedures and updating the SMS."

This statement implies that main tasks remain almost same, but the system control structure showed significant change. Shore-based managements' more involvement is an indication that present inspections are now grounded in a broader system rather than just onboard preparation.

"Engine room work is still the same, but you feel that pressure in the background, like you need to be more alert all the time."

In this case, changes in inspections can have a psychological impact. Even though tasks did not see any changes, awareness was raised due to the presence of an inspection framework that focuses on real practices. This reflects how realism in SIRE 2.0 influences crew members and how it works on both the operational and behavioral levels.

4.3.2 Practical and Contextual Relevance

Participants emphasize that SIRE 2.0 has noticeable impact on how work is actually performed and justified while it supports the backbone of the real operating system. The system uses procedural approach to guide crew members for completing tasks and shifts from experience-driven execution.

"Before, we could do tasks based on experience because we already knew how to perform them, but now we need to check procedures even for familiar work."

This states that experience alone is not sufficient to perform tasks; instead, each operations must be validated by procedures. It creates more controlled and organized working environment, as crew members are required to demonstrate their compliance knowledge.

“Preparation is different now: it’s more about checking SMS updates and knowing procedures rather than just hardware.”

Participants make a point that performing tasks, preparing the vessel, is not adequate for the inspection regime, but also knowing the procedural context and explaining it when it is needed. It means that competency is redefined as the ability to connect performed tasks with documented knowledge.

These findings indicate that realism is expressed through a behavioral transformations where operational practices are reshaped to accommodate a more procedure-oriented and intellectually demanding working style.

4.3.3 Credibility of Evidence-Based Assessments

Beyond operational alignment and behavioral changes, participants also mention how inspections are conducted to evaluate and validate. Since SIRE 2.0 focuses on documentation evidence rather than observation-based judgment, inspections are also subject to change to verify operations onboard.

“You prepare all files, upload documents… inspector gets all vessel particulars, maintenance work, certificates in advance.”

This indicates that inspections begin before the inspector gets on board, and that data guides inspections’ direction and focus. As a result, the nature of the inspections becomes more than exploratory but more confirmatory.

“Inspector already has photographs, certificates… that saves a lot of time.”

Here, efficiency is not the only outcome. The availability of documents also enhances the perception of objectivity; decisions are supported by traceable information, thus, inspectors have little room for interpretation.

4.4 Impacts on Workload and Working Conditions

Participants point out that new structure introduced by new system adds different layer of workload and pressure. SIRE 2.0 seems to change the distribution of the workload across the organizations rather than simply adding more work. The results suggest that workload changes are not one-dimensional; they affect administrative demands, time limits, and psychological pressure.

4.4.1 Administrative Burden

A common theme in the interviews is the perceived increase in administrative duties keep growing and it is particularly linked to documentation and procedural compliance. Participants add that not only before inspections, but also daily tasks require more paperwork and formal systems must be updated.

"Paperwork such as ISM and SMS has increased, at least in the beginning."

This indicates that introduction of the SIRE 2.0 increased the demand at first to align systems to new requirements. In order to demonstrate continuous compliance, the focus on documentation becomes a vital part to provide traceability and accountability.

"For the companies there are much more procedures and one company produced 33 new procedures in six months."

This quotation shows that it is not only people who work onboard but also shore personnel is affected by administrative demand. The quick growth of procedures suggests that workload is redistributed rather than reduced. Organizational level takes up more responsibility over procedural facts and making sure rules are followed.

These findings imply that SIRE 2.0 increases workload by adding more procedures and documentation which is hard to stay in compliance since it creates time pressure and cost.

4.4.2 Time Pressure and Work Intensification

Aside from administrative demands, the reason for the intensified workload is time constraints, particularly preparation for inspections and follow-up after inspections.

"Since we need to fix all the observations within a time limit, it becomes more work after the inspection."

This illustrates that the distribution of workload is not even and it tends to build up around certain events, especially after inspections. The observation with limited time frame creates sense of urgency which amplifies the work intensity.

"On board there is a little more workload in the beginning because implementing all those procedures takes time."

Here it is same. Adding more procedures increases the amount of work but it also force personnel to do their tasks in limited timeframes, especially during transition periods.

Overall, these findings suggest that SIRE 2.0 intensified workload by adding not only more procedures but also a limited timeframe which increases pressure on both individuals and teams.

4.4.3 Mental and Physical Strain

Participants emphasize that beyond workload, atmosphere during inspections changes drastically. The evaluative nature of inspections impacts behavior and interaction on board, adds a level of stress to crew members.

"When inspector is on board, atmosphere changes a bit. Everyone becomes more serious and focused on their job."

Working environment becomes more controlled and crew members focuses on their performance. This is not a negative indication it just highlights how inspectors' existence on board influences people's moods and attention.

"People talk less and focus more on their tasks because they don't want to make mistakes in front of inspector."

This quotation further emphasizes that crew members reduce informal communication and adjust their behavior since they are being watched.
These results show that SIRE 2.0 creates a kind of psychological workload, where stress comes not just from tasks but also from being more aware, responsible, and evaluated.

4.4.4 Confusion and Ambiguity

Even though structural and standardization improvements, participants share that ambiguity remains in some cases, due to differences in how inspectors conduct inspections. Sometimes this can lead to a tension between formal consistency and practical variability.

"It still depends on the inspector and how strict they are, so there is always some variation."

Crew members cannot rely solely on what is documented since human factors still impact outcomes even if the system aims to standardize inspections.

"We generally know what to expect, but the focus and order of the questions can shift, so we need to stay flexible and ready to respond."

This quotation emphasizes how uncertainty is experienced, and inspection itself can create disorder that leads to confusion. This confusion can manifest through shifting inspection flow. Crew members must continuously coordinate and adjust their attention during inspections.

Taken together, SIRE 2.0 does not eliminate uncertainty but it prepares crew members to be more flexible and dynamic. This uncertainty is result of situational changes rather than a from a lack of structure.

4.5 Improvements in Work Environment and Safety Culture

SIRE 2.0 brought additional workload and pressure to crew members but participants also emphasize the improvements in how work is experienced onboard. Organizational improvements, clearer expectations and more structured interaction with safety practices constituted safe working environment and culture. In general, SIRE 2.0 provided solid frame for perception of safe practices and contributed to a more controlled working environment.

4.5.1 Increased Awareness and Safety Mindset

Participants indicate that crew member are more aware of how things are done and how they approach even routine tasks.

"Before we could rely more on experience, but now we always check what the procedure says before doing the job."

This quotation states that awareness is not something expected from crew members but actually it is reinforced into the system. Actions are continuously evaluated against formal expectations.

"It becomes a habit to think about procedures even outside inspections, because you know it can be checked at any time."

This statement is an example of how SIRE 2.0 impacts daily tasks. The system lays the groundwork for crew members to apply safe practices and also creates safety culture in order to keep the vessel ready continuously.

4.5.2 Improved Communication

Participants describe major updates in the communication flow; planning and coordination of the whole inspection process is more effective.

"The inspection is discussed in advance and we agree on how to go through it, which makes the process smoother."

This indicates that communication is becoming more proactive, reducing uncertainty and enabling better coordination between crew and inspectors.

“There is more coordination now, especially at the beginning, which helps everyone understand their role during the inspection.”

Inspectors describe how they will perform inspections and prevent any misunderstanding that may arise during the process. Crew members become aware of their responsibilities.

4.5.3 Learning and Development Opportunities

Participants also describe how SIRE 2.0 creates new learning opportunities, promotes involvement with procedures and system requirements.

“Now we spend more time understanding why things are done in a certain way, not just how to do them.”

SIRE 2.0 requires more time and energy from crew members so that they can answer “why” questions. Reasoning behind the tasks is as important as executing them. It also provides deeper knowledge, thus a more analytical and knowledge-based approach to work.

“When something is missing, we need to follow up with the office and sometimes develop new procedures, so you learn along the way.”

Updating and creating new procedures facilitates growth in both individual and organizational level. It fosters continuous development both on board and ashore. These findings indicate the role of SIRE 2.0 in individual learning to develop knowledge.

4.5.4 Strengthening of Safety Culture

The participants expressed that structural development brought by SIRE 2.0 reinforces safety culture and makes crew members more accountable for their actions.

“The system makes everything more visible, so you cannot ignore things that were maybe overlooked before.”

Increased transparency strengthens safety, which leads to easier monitoring and evaluating of actions and conditions.

"You just feel like you have to do everything by the book, because you know that at any moment during an inspection, they could point at something and ask 'why?'"

This reflects how safety culture on board is reinforced by not only personal initiative but by a mechanism that holds crew members accountable for each activity. The possibility to be questioned any moment encourages people to be more aware of procedures and creates more disciplined working environment to build around safety culture.

Taken together, these findings suggest that visibility, accountability and structural aspects of SIRE 2.0 reinforced safety culture to create a safe working environment.

5. Discussion

The findings out of this study show a clear pattern. The introduction of SIRE 2.0 has led to an increase in workload and caused to higher stress levels initially. However, it seems like this will not be a permanent, more like an early adjustment phase. Despite this, crew members do not in general perceive SIRE 2.0 as an additional burden. Many participants describe the system as a good upgrade as they become more familiar with it and understand what is expected from them. This aligns with previous research that states new framework initially increase demands but overtime it stabilizes (Aarskog et al., 2020; Flach, 2012).

The increase in workload is evident, but the nature of the increase is more nuanced than a simple increase in operational tasks. The data does not indicate that crew members are having new or additional duties. Instead, the increase is seen around paperwork, preparation and the need to articulate and demonstrate operational knowledge during inspections. Tanker operations require administrative and compliance-related tasks in order to continue to operate vessels and with the addition of the new framework, it becomes more demanding on crew and shore personnel (Baygi et al., 2022).

When it comes to the viewpoint of shore-based personnel, workload increase is relatively straightforward. Certificates and inspection-related data must be prepared even before the inspector arrives on board. New trend in maritime governance where digitalization and documentation become a vital part of the proactive approach have increased the workload which leads to higher stress levels on both sides of the shipping industry (OCIMF, 2022; Panayides, 2019).

From an onboard perspective, the volume of the tasks did not show big differences as it is more about visibility and accountability. Now, crew members need to explain what they do, how they do it and why they do it in a certain way. So it is not only about “doing the job” but “showing competence” under new framework SIRE 2.0 which introduces an additional cognitive layer to everyday tasks. Similar observations have been made in other studies of human-centered inspection systems, where performance demonstration becomes part of the workload and affects routine operational tasks (Aarskog et al., 2020; Flach, 2012).

This shift is especially obvious in the case of ratings such as ABs. The results indicates that these crew members experience more pressure as they become more involved in the inspection process. In addition to physical, they face cognitive and psychosocial workload ,which is new to them. Demonstrating knowledge for daily tasks, being able to respond questions and be evaluated directly increases perceived pressure. Previous research emphasize that maritime operations is strongly influenced by cognitive demand have a great effect on workload rather than only physical task (Kim et al., 2016; Baygi et al., 2022). For ratings it is unprecedented, since they are held accountable for their actions and knowledge over tasks more deeply.

Findings also indicate that this increase in workload is not the same for each role. Shore personnel experience an increase in administrative workload, while crew members experience how their work is evaluated. This supports the idea that modern safety systems redistribute workload across organizational levels rather than just increasing it (Panayides, 2019; Aarskog et al., 2020).

The second thing is why this increase appears to be temporary. The results points toward a process of adaptation. Participants described that first inspections under new system was perceived more demanding, in terms of preparation and understanding it. However, after a couple of inspections, crew members became more familiar with the process, and they understood the expectations; thus, the level of uncertainty has dropped significantly.

The theory of socio-technical systems can explain this pattern. Initially, new systems are more demanding on cognitive and coordination side but these demands stabilize as people adapt and routines develop (Flach,2012). Another research states that transition to more advanced systems often brings more workload before reaching a new equilibrium (Aarskog et al., 2020; OCIMF, 2022).

At the same time, it is important to approach this conclusion with some caution. SIRE 2.0 is relatively new system and its long-term effects cannot be fully verified. However, statements of the participants imply that they believe the workload will reduce over time, as perceived temporality impacts acceptance and adaptation (Kim et al., 2016).

The most interesting outcome is why, despite the initial burden, participants have a generally positive review of SIRE 2.0. This finding is actually not in line with previous literature, which often associates increased workload with negative perception (Baygi et al., 2022).

One important reason is the improved structure and predictability of the inspections. Participants share that SIRE 2.0 is more organized and transparent in terms of expectations. This reduces uncertainty which is a major source of stress in high-risk environments (Kim et al., 2016; Panayides, 2019). Being able to know what will be assessed allows crew members to prepare more effectively.

This is also a clear message about the limitations of traditional vetting systems. Traditional vetting systems have been criticized for being overly dependent on checklists while allowing significant inspector subjectivity (Aarskog et al., 2020; Bloor et al., 2013). Introduction of the SIRE 2.0, aside from structural improvements and an evidence-based approach, also contributed to the fairness of inspections by limiting inspectors' subjectivity.

Another important fact is the increased involvement of the crew members. Initially, it adds pressure to their daily life but in the long run they become more familiar with whole operational sequence. This also gives them confidence for applying procedures and reduces dependence on officers and system becomes more stronger in general. Research on safety culture supports this by emphasizing the importance of shared knowledge and collective responsibility, which are critical for safe operations in complex environments (Kim et al., 2016).SIRE 2.0 acts as an indirect teaching mechanism which mandates individuals to be more familiar with operations and engagement with procedures.

Finally, the results indicate that SIRE 2.0 improves operational efficiency, although not by reducing workload. Instead, it is improved by better planning, structure and coordination. Inspections are more organized, with meetings prior to inspections, structured schedules, and minimized disruption to operations. Broader research indicates that efficiency in complex systems is connected to coordination and predictability rather than speed (Panayides, 2019; Flach, 2012). SIRE 2.0 enables more efficient inspection processes by integrating its procedures into operational workflows.

Overall, these findings indicate a shift in the nature of the work with SIRE 2.0. It moves the focus from routine execution and documentation to readiness, communication and demonstrating capability. While it creates challenges, it also has benefits to build solid framework, improve transparency and safer operations.

In conclusion, the impact of SIRE 2.0 cannot be understood simply in terms of increased or decreased workload. Instead, it transforms how work is experienced and evaluated. The initial increase in workload and stress appears to be a transition phase which is expected to stabilize over time. At the same time, the system is perceived as more structured, predictable and fair, which explains the general positive reaction from crew members.

6. Conclusion

The purpose of this thesis was to explore the effects of the SIRE 2.0 on the workload, work environment, and operations of tanker vessels, particularly focusing on human factors and daily practices. This study examined how safety practices was built through human interaction, procedural compliance and company culture, instead of using quantitative statistics such as accident reports. The thesis provides insight into how new inspection regime which is more dynamic and human-centered is experienced by crew members, by adopting a qualitative approach based on semi-structured interviews.

To conclude, the results indicate that SIRE 2.0 has an impact on both workload and the work environment, introducing improvements in the working structure and increasing operational demands.

On one hand, new system's setup allows crew members to plan more effectively since predictability, structure and transparency is enhanced by SIRE2.0. They can distribute tasks more clearly and operate within a more controlled workflow. This results in more organized working environment compared to previous inspection regimes. Structural improvements enable clearer communication and expectations, leads to smoother operational flow. Also, it supports better coordination both onboard and between ship and shore.

On the other hand, these improvements caused significant increase in administrative workload and procedural requirements. Maintaining continuous compliance checks, updating documentation creates extra pressure. This reflects the shift from inspection-based preparation to continuous readiness; it is more evenly distributed but also has a more constant workload over time.

Furthermore, the findings emphasize the importance of human factors on the work environment. Despite standardization, crew members face variety in inspection practices due to inspectors' subjectivity which forces them to stay flexible and responsive, results in dynamic environment where predictability coexist with uncertainty. As a result, working environment becomes more structured but also more demanding. It requires adaptability and cognitive engagement skills from crew members.

In addition, the study reveals a noticeable psychological dimension to inspections. Inspections impact onboard atmosphere, increasing focus, seriousness and stress. This suggests that workload should not be considered only as physical but also in relation to mental health.

Overall, SIRE 2.0 reshapes the work environment by providing more structured, controlled and transparent approaches, yet also more demanding and intensive, where safety practices is built by continuous human engagement with procedures.

The findings also suggest that SIRE 2.0 has a complex and multidimensional influence on operational efficiency. The new system requires higher operational effort but brings quality and consistency in the inspection regime. A key positive outcome is that structural changes increase efficiency and standardization through digital tools and the sharing of pre-inspection data, which cuts down repetitive checks and allows inspections to be conducted in a more

streamlined way. This reduces uncertainty and last-minute changes because crew members have clearer expectations and are better prepared.

In addition, the SIRE 2.0 questionnaire aligns with real operational practices, making evaluations more relevant. The system has a more “realistic” approach to daily work, which enables greater efficiency by integrating with actual operations rather than providing superficial compliance. From this perspective, operational efficiency is not only about speed or workload but also about the relevance and improving quality.

However, these benefits are offset by the increased emphasis on documentation, procedural compliance, and follow-up actions. Procedural expansion and the need for continuous verification add additional layers of work and it can reduce efficiency in the short term. In particular, post-inspection activities and corrective actions generate time pressure and prolong the operational impact of inspections.

One of the most significant indications under SIRE 2.0 is the close linkage of human adaptability and competence. The system, in a way, tests crew members whether they can interpret, apply, and respond to procedures in varying contexts. This suggests that efficiency is no longer driven only by technical systems; instead, it measures crew members’ abilities, whether they can perform their daily tasks responsibly and take action as needed.

Moreover, SIRE 2.0 creates opportunities for growth within the system for crew members by enabling more involvement with procedures that help to form a strong safety culture. Also encouraging continuous learning and being exposed to reflection on practices, the system supports more sustainable operations in the long term. In this sense, SIRE 2.0 shifts the concept of efficiency from an output-oriented perspective to a more holistic one by integrating reliability, consistency, and safety.

6.1 Recommendations for Future Research

Since SIRE 2.0 is still in the early stages, further research should aim to better understand its long-term effects on operations and the working environment onboard. An increase in workload and procedural requirements was described by participants in this study as an adaptation phase, but future studies could ascertain whether operational pressure will decrease over time. Future research should also examine whether the human-centered approach introduced by SIRE 2.0 improves safety performance by integrating qualitative results to measure its effectiveness.

In this thesis, the target group is Swedish tanker operators thus research that involves componies from different countries which has bigger fleet and different organizational cultures may provide a broader understanding of the SIRE 2.0 implementation. Also inspector perspective remains underexplored ant their perspective might offer valuable insight into understanding the inspection system.

Finally, future research should continue to examine SIRE 2.0 as a socio-technical system and not as a technical inspection framework only. The results of this thesis suggest that the system does not affect only compliance and routines but also communication, safety culture, and organizational behavior. Focusing on the balance between administrative requirements

and operational efficiency could contribute to more sustainable shipping practices as further research develops.

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