



POTENTIAL

COVID-19 RELATED

MARITIME SAFETY ISSUES

AND EMERGING RISKS

About this study:

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List of Abbreviations

BIMCO	Baltic and International Maritime Council
CAMMSE	Center for Advanced Multimodal Mobility Solutions and Education
CRII	Coronavirus Response Investment Initiative
CRII+	Coronavirus Response Investment Initiative Plus
COVID-19	Coronavirus disease
DPA	Designated Person Ashore
EC	European Commission
ECSA	European Community Shipowners' Associations
EEA	European Economic Area
EFTA	European Free Trade Association
EIF	European Investment Fund
EMSA	European Maritime Safety Agency
EMFF	European Maritime & Fisheries Fund
ESCWA	Economic and Social Commission for Western Asia
EU	European Union
EUMOFA	European Market Observatory for Fisheries and Aquaculture Products
FAO	Food and Agriculture Organization
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System
GT	Gross Tonnage
HR	Human Resource
IAMU	International Association of Maritime Universities
IACS	International Association of Classification Societies
ICS	The International Chamber of Shipping
IGOs	Intergovernmental Organizations
ILO	International Labour Organization
IMO	International Maritime Organization
INMARSAT	International Maritime Satellite Organization
INTERTANKO	International Association of Independent Tanker Owners
ISM Code	International Safety Management Code
ISWAN	International Seafarers' Welfare and Assistance Network
ITF	International Transport Forum
IUU	illegal, unreported, and unregulated
ICS	The International Chamber of Shipping
LOA	Length Overall
LR	Lloyd's Register
MLC	Maritime Labour Convention
MtS	The Mission to Seafarers
NGOs	Non-Governmental Organizations
NLP	Natural Language Processing
NOAA	National Oceanic and Atmospheric Administration
OEM	Original Equipment Manufacturer
PCR	Polymerase Chain Reaction
PPE	Personal Protective Equipment
PSC	Port State Control
SCAT	Seafarer Crisis Action Team
SEAFDEC	Southeast Asian Fisheries Development Centre
SI	Safety Issue
SME	Small and medium-sized enterprises
SOP	Standard Operating Procedures
UK	The United Kingdom
UN	United Nations
UNECE	United Nations Economic Commission for Europe

UNGA	United Nations General Assembly
UNCTAD	United Nations Conference on Trade and Development
US	United States
USITC	The US International Trade Commission
VTS	Vessel Traffic Services
WHO	World Health Organisation
WMU	World Maritime University
WISTA International	Women's International Shipping and Trading Association
ESIF	European Structural and Investment Funds

Executive Summary

The COVID-19 pandemic has acted as a real test for the global maritime industry, in particular testing its resilience. This study comprising original comprehensive research has endeavoured to thoroughly examine the range of challenges and variations that have emerged within the industry during this extraordinary crisis. It aimed to identify the consequences for maritime safety, detect potential risks, and develop a set of mitigation strategies that can enhance the industry's readiness for similar future disruptions.

Novelties of the study
<ul style="list-style-type: none"> ▪ Original comprehensive research ▪ Explicit focus on maritime safety ▪ Extended time scope covering pre-pandemic, pandemic and post-pandemic period ▪ Elicitation of changes to normal operations ▪ Identification of potential safety issues and emerging risks ▪ Evaluation of the degree of transience of the detected safety issues ▪ Examples of best practices ▪ Identification of lessons learned ▪ Recommendations for resilience

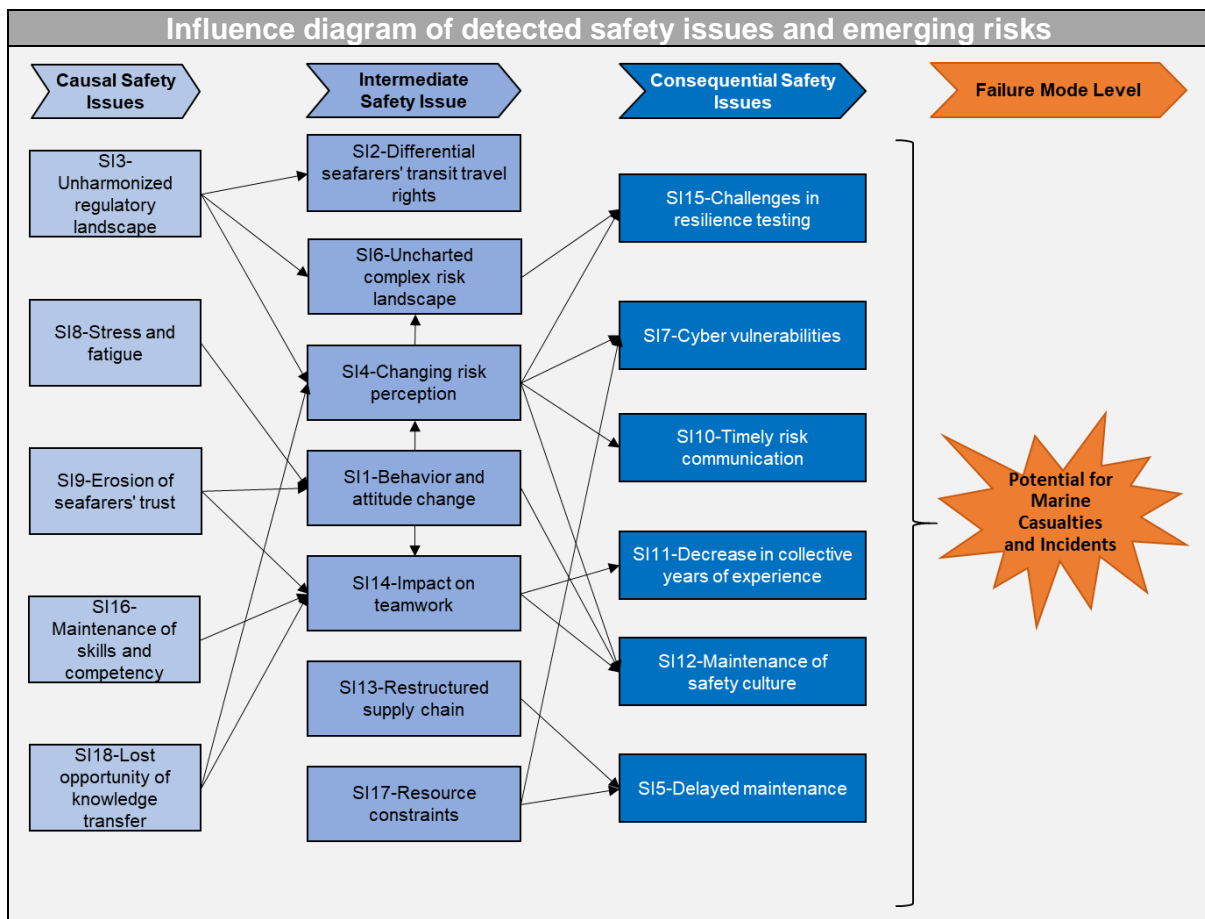
The global maritime industry, including the EU maritime sector, experienced significant repercussions during the pandemic. Seafarers, key to maritime operations, faced among other things, the challenges of extended contracts and mental stress from extended periods of isolation. Shipping companies rapidly transitioned to remote operations, adapting to changed circumstances where conventional practices were disrupted. This shift in operations, however, was complicated by interruptions in people mobility, vital supply provision, ship maintenance and crew training schedule. This situation highlighted the necessity for a comprehensive assessment of the pandemic's overall impact on maritime safety.

Study parameters
<ul style="list-style-type: none"> ▪ Operations in the realm of the ship <ul style="list-style-type: none"> ○ 11 types of operations ○ 87 identified baseline indicators ▪ Operations in the realm of the company <ul style="list-style-type: none"> ○ 5 types of operations ○ 37 identified baseline indicators ▪ Operations requiring collaborative effort <ul style="list-style-type: none"> ○ 7 types of operations ○ 5 in the realm of the ship and 3 on the shoreside

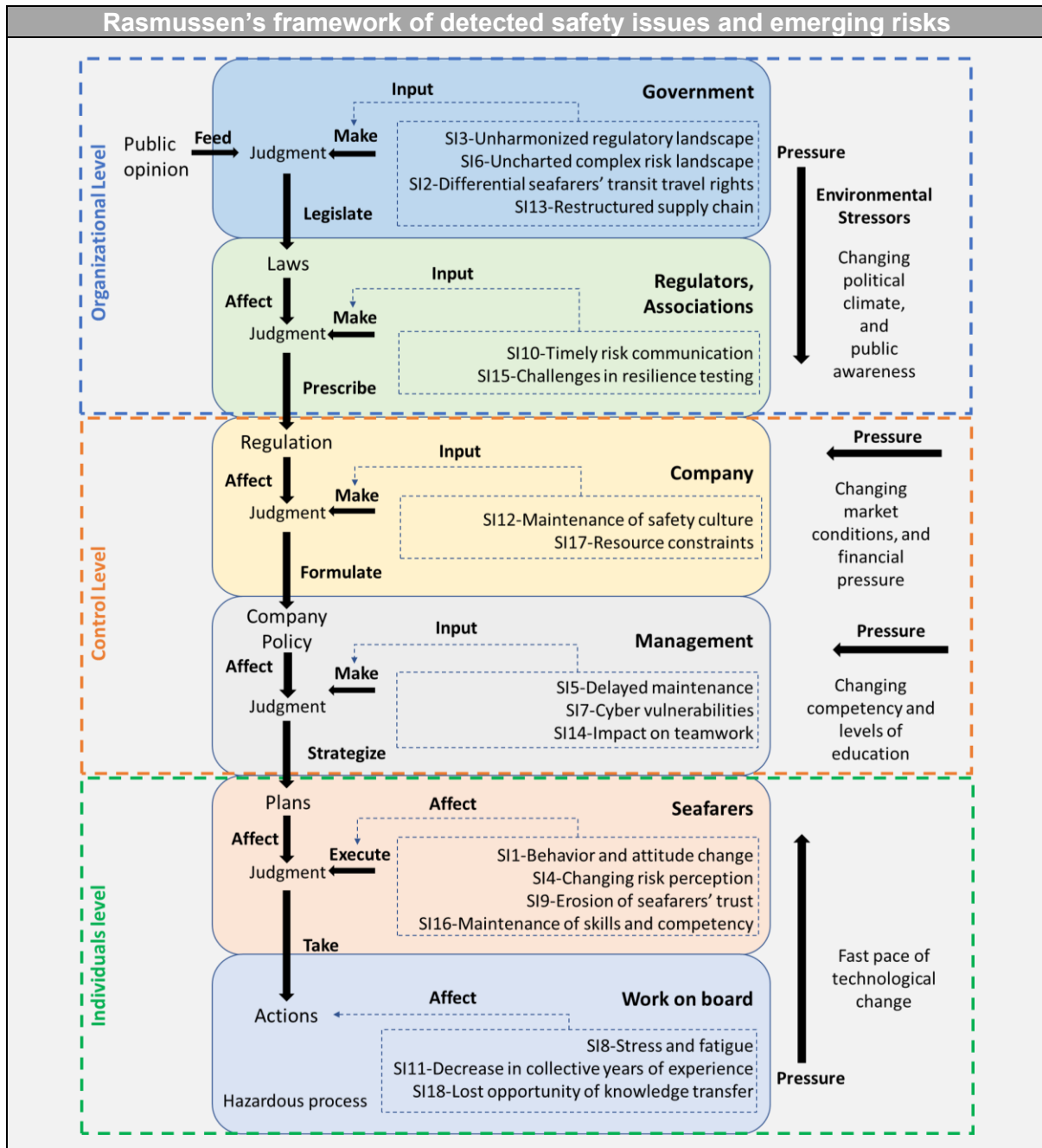
This study utilized a mixed-method approach that incorporated both qualitative and quantitative data from a broad range of sources, including first-hand accounts from seafarers, shipping company staff, and other maritime safety experts. Through this holistic lens, the study aimed to examine the complex array of challenges that unfolded across the maritime industry. It was assumed that the pandemic had a destabilising effect on the industry, likely introducing a variety of safety issues and risks to the maritime industry.

- | Data sources for the study | |
|----------------------------|---|
| ▪ | 15 reports by organizational entities |
| ▪ | 117 academic articles on COVID-19 and maritime safety |
| ▪ | 24 seafarer’s interviews |
| ▪ | 61 shipping company personnel interviews |
| ▪ | 10 fishers’ interviews |
| ▪ | 5 fishing enterprise personnel interviews |
| ▪ | 370 online survey responses |
| ▪ | 45 online expert survey responses |
| ▪ | 15 experts focus group discussion in-person |

Based on the review of literature and survey of stakeholder participants, the study identified and analysed eighteen potential safety issues arising from the COVID-19 pandemic.



By applying Rasmussen's risk management model—a well-known framework in the literature—the study categorized the safety issues across three distinct levels: organizational, control, and individual. This categorization aimed to facilitate the exploration of nuanced interventions by the relevant maritime stakeholders. At the organizational level, issues such as differential seafarers’ transit travel rights, an unharmonized regulatory landscape, changing risk perception, an uncharted complex risk landscape, timely risk communication, a restructured supply chain, and challenges in resilience testing were apparent. The control level highlighted issues like delayed maintenance, heightened cyber vulnerabilities, and the maintenance of safety culture—a concern that extends to the individual level as well. At the individual level, the focus was on changes in behaviour and attitude, the erosion of seafarers' trust, the retention of skills and competency, increased stress and fatigue, a reduction in cumulative experience, adverse effects on teamwork, and missed opportunities for knowledge transfer.



The temporal assessment of the identified safety issues revealed that while some were transitory – such as behaviour and attitude changes, unharmonized regulatory landscape, differential seafarers' transit travel rights and changing risk perception – and effectively attenuated by the industry's adaptive measures, others such as cyber vulnerabilities, maintenance of safety culture, restructured supply chain, and lost opportunities for knowledge transfer exhibited a more persistent nature, signalling the need for continued monitoring and strategic management.

Categorization of emerging risks as per significance and degree of transience		
Mitigation category	Mitigation strategy	Target safety issue
Category 1 <i>Significance: very high</i> <i>Transience: short to mid-term</i>	full and urgent attention and urgent resources	<ul style="list-style-type: none"> SI1-Behavior and attitude change SI2-Differential seafarers' transit travel rights

<p>Category 2 Significance: high Transience: short to mid-term</p>	<p>high attention and immediate resources</p>	<ul style="list-style-type: none"> ▪ SI3-Unharmonized regulatory landscape ▪ SI4-Changing risk perception ▪ SI5-Delayed maintenance ▪ SI8-Stress and fatigue ▪ SI9-Erosion of seafarers' trust ▪ SI10-Timely risk communication ▪ SI11-Decrease in collective experience
<p>Category 3 Significance: high Transience: persistent</p>	<p>high investment and high, sustained attention due to complex nature of risk</p>	<ul style="list-style-type: none"> ▪ SI6-Uncharted complex risk landscape ▪ SI7-Cyber vulnerabilities
<p>Uncategorized Significance: moderate to low Transience: persistent</p>	<p>may be addressed as deemed fit with no specific timeframe</p>	<ul style="list-style-type: none"> ▪ SI12-Maintenance of safety culture ▪ SI13-Restructured supply chain ▪ SI14-Impact on teamwork ▪ SI15-Challenges in resilience testing ▪ SI16-Maintenance of skills and competency ▪ SI17-Resource constraints ▪ SI18-Lost opportunity of knowledge transfer

Building on the proactive stance in risk management, the identification of early warning indicators, specifically tailored to the maritime context, is essential for enhancing safety and ensuring operational continuity. As an integral part of this approach, this study proposes the systematic collection and analysis of data, which includes, among others, monitoring seafarers' behavioural trends, job satisfaction, cybersecurity incidents, and mental health records. Such data would form the cornerstone for tracking the emergence and evolution of safety issues, allowing for the prioritization of mitigation measures and enabling the maritime industry to stay ahead of the curve in managing these risks.

Possible precursors of select safety issues and emerging risks	
Emerging Safety Issue	Potential Precursors
<p>SI1-Behaviour and attitude change</p>	<ul style="list-style-type: none"> ▪ Increase in the number of interpersonal conflicts on board ▪ Negative feedback from psychological assessment tests ▪ Increase in reported safety and operational protocol variabilities ▪ Decline in job satisfaction survey scores ▪ Deterioration in crew communication quality
<p>SI2-Differential seafarers' transit travel rights</p>	<ul style="list-style-type: none"> ▪ Increase in the number of crew stranded in foreign ports ▪ Increase in the amount of time, spent/dedicated to processing travel documents required for repatriating crew members at a given port ▪ Increase in seafarer abandonment cases related to repatriation
<p>SI3-Unharmonized regulatory landscape</p>	<ul style="list-style-type: none"> ▪ Increase in disputes or appeals relating to vessel detentions or penalties ▪ Negative feedback from ship operators about challenges in adhering to differing standards when transitioning between jurisdictions
<p>SI4-Changing risk perception</p>	<ul style="list-style-type: none"> ▪ Discrepancies in safety reporting such as near miss reporting ▪ Increase in reported safety and operational protocol variabilities

SI5-Delayed maintenance	<ul style="list-style-type: none"> ▪ Increase in number of equipment failures ▪ Increase in number of equipment malfunction reports ▪ Extensions in maintenance schedules ▪ Delays in onboard planned maintenance ▪ Increase in number of incidents attributed to equipment failures ▪ Increase in safety related critical equipment deficiencies during inspections (e.g., flag State, port State) such as fire detection and fighting equipment
SI6-Uncharted complex risk landscape	<ul style="list-style-type: none"> ▪ Rapid involvement of technological adaptations such as new fuels, digitalization, autonomous vessels, and other precursors can be specific to the operations
SI7-Cyber vulnerabilities	<ul style="list-style-type: none"> ▪ Increase in the number of system glitches recorded over time ▪ Increase in the reports of suspicious online activities ▪ Unusual network traffic patterns ▪ Delays and disruptions in operations due to IT related issues
SI8-Stress and fatigue	<ul style="list-style-type: none"> ▪ Increase in the number of interpersonal conflicts on board ▪ Negative feedback from psychological assessment tests ▪ Increase in the frequency of the use of sick leave or medical consultations ▪ Increase in the number of near miss incidents due to attention lapses ▪ Increase in incidents attributed to navigation or equipment handling errors
SI9-Erosion of seafarers' trust	<ul style="list-style-type: none"> ▪ Discrepancies in safety reporting such as near miss reporting ▪ Decline in job satisfaction survey scores ▪ High turnover rates, low retention rates
SI10-Timely risk communication	<ul style="list-style-type: none"> ▪ Increase in the number of incidents attributed to unawareness of the hazards or risk, and other precursors specific to the operations
SI11-Decrease in cumulative years of experience	<ul style="list-style-type: none"> ▪ High turnover rates, low retention rates ▪ Lower average years of experience in crew
SI12-Maintenance of safety culture	<ul style="list-style-type: none"> ▪ Increase in reported safety and operational protocol variabilities ▪ Negative feedback from safety culture surveys
SI13-Restructured supply chain	<ul style="list-style-type: none"> ▪ Increase in equipment procurement times, delays ▪ Feedback on supplier reliability ▪ Other precursors specific to the operations affected by the supply chain
SI14-Impact on teamwork	<ul style="list-style-type: none"> ▪ Increase in the number of incidents attributed to communication gaps and team coordination (bridge team or engineering team) ▪ Increase in task redundancies based on supervisors' feedback ▪ Deterioration in crew communication quality
SI15-Challenges in resilience testing	<ul style="list-style-type: none"> ▪ Availability of the resilience plans and actions of maritime stakeholders (shipping companies, governments, ports, etc.) against crises and disruptions, and other precursors specific to the operations
SI16-Maintenance of skills and competency	<ul style="list-style-type: none"> ▪ Increase in the number of deficiencies and remarks in inspections related to crew performance during safety drills and other safety emergencies

	<ul style="list-style-type: none"> Increased number of incidents attributed to human error particularly skills and competency related
SI17-Resource constraints (impact on safety investment)	<ul style="list-style-type: none"> Delays in safety equipment replacements Reports of insufficient onboard resources Reduction in safety investment of maritime stakeholders Reduced availability of crew amenities onboard
SI18-Lost opportunity of knowledge transfer	<ul style="list-style-type: none"> Delays and disruptions in operations attributed to the lacking in familiarization Increased number of incidents attributed to lack of familiarization High turnover rates Low retention rates (early retirement or move to shore-based jobs)

The study also delved into the EU fishing industry, where COVID-19 led to considerable challenges, testing its resilience and highlighting its dependencies on supply chains and market stability. The industry's response to the pandemic revealed the importance of crew well-being, as the immediate fear of virus transmission and subsequent isolation measures significantly impacted mental health, potentially leading to enduring issues.

Thematic overview of fisheries reports	Thematic overview of impact in fisheries
<ul style="list-style-type: none"> Supply chain disruptions Economic impact Consumer behaviour Small-scale fisheries Government and policy responses Adaptation and resilience strategies Employment challenges 	<ul style="list-style-type: none"> Human and operational impact Economic shifts and market evolution Regulations and governance Technological advancements and fishing industry adaptations Community engagement, collaboration and sustainability Future outlook and resilience

The pandemic led to a decline in available qualified labour within the fishing industry, raising concerns over the long-term maintenance of safety standards. Financial hardships prompted by fishing market volatility threatened essential safety investments, with potential cutbacks in crew training and vessel upkeep. Delays in regular inspections and repairs due to the pandemic posed immediate operational risks and could undermine the efficiency and safety of fishing practices in the long run.

Emerging risks and potential safety issues in the fishing industry
<ul style="list-style-type: none"> Crew well-being Qualified labor shortages Market fluctuations and financial strain Delay in inspections and repairs

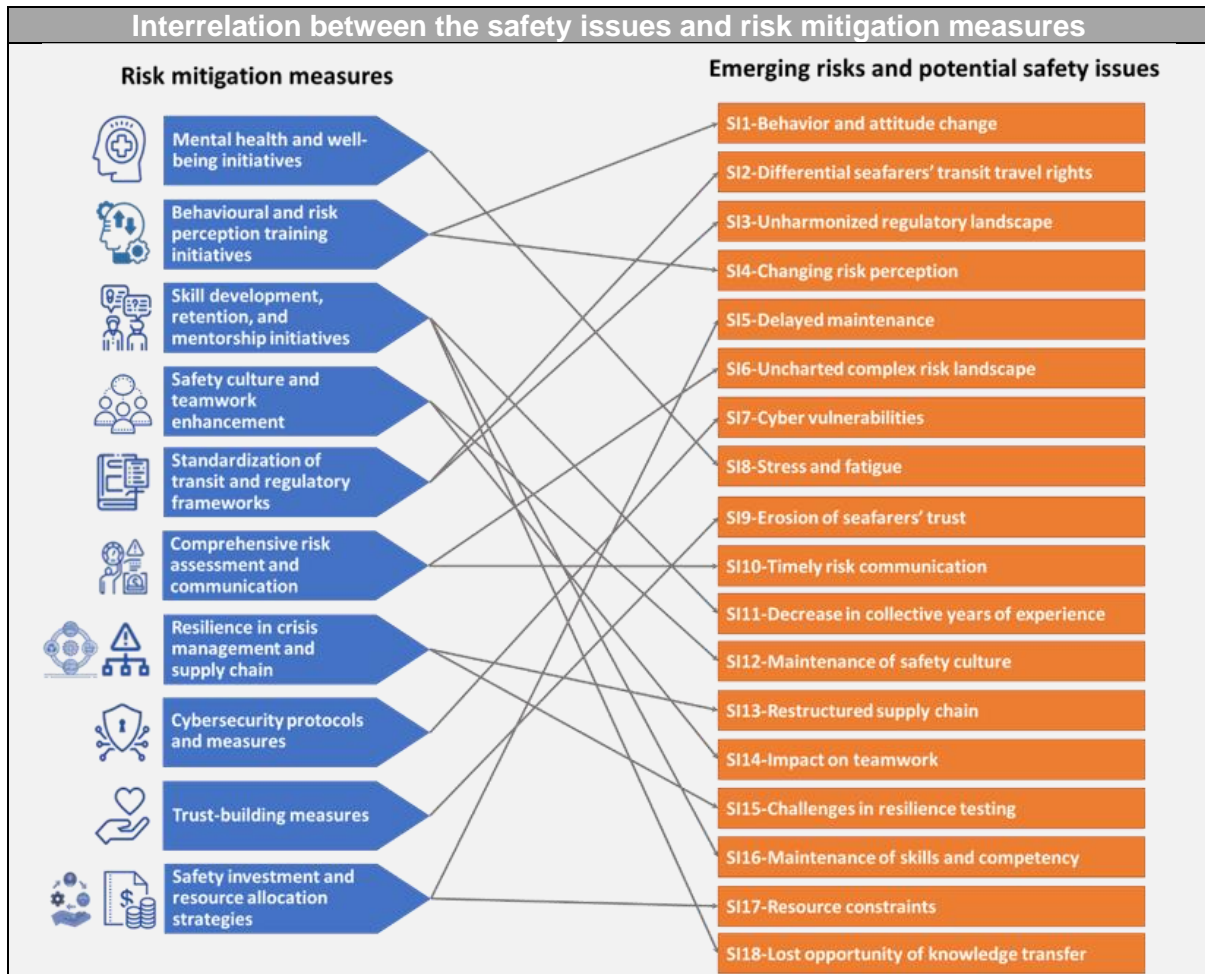
Efforts by international organizations and the European Commission, along with EU Member States, demonstrated flexibility, offering health protocols and financial support. The fishing industry's experience during the pandemic highlighted the need for robust health and safety protocols, mental well-being support, crisis preparedness, and adaptability. Moving forward, supply-chain resilience, sustainable financial management, strong commitment to safety, and effective communication will be pivotal in navigating future challenges.

Lessons learned from Covid19 in the fishing industry	
Shipboard side	Fishing enterprise side
<ul style="list-style-type: none"> ▪ Importance of health and safety ▪ Crisis preparedness ▪ Mental well-being awareness ▪ Adaptability and flexibility 	<ul style="list-style-type: none"> ▪ Supply chain resilience ▪ Financial planning and sustainability ▪ Investment in safety ▪ Collaboration and immunization

This study provides a comprehensive overview that illustrates the maritime and the fishing industry's resilience in the face of the pandemic and also underscores the need for a cohesive safety and operational structure across the EU and the globe. It calls for an enhanced focus on commercial shipping seafarers' welfare, the establishment of uniform safety protocols, and reinforced collaboration for building a proactive, robust maritime and fishing infrastructure. The challenges experienced by the EU fishing industry, notably in crew well-being and operational stability, further emphasize this need. Integrating the proposed strategic mitigation measures could steer both the EU shipping and fishing sectors towards increased safety, operational efficiency, and a robust workforce.

Lessons learned from Covid19 for the maritime industry	
Lessons learned	Key takeaways
Adaptability and resilience	<ul style="list-style-type: none"> ▪ Importance of flexibility and robust planning of maritime operations ▪ Strategic operational adjustments to respond global lockdowns
Preparedness and effective communication	<ul style="list-style-type: none"> ▪ Necessity of established and harmonized contingency plans ▪ Importance of clear, timely, and effective communication ▪ Preparedness to handle miscommunications and related operational challenges ▪ Importance of clear and harmonized protocols for unprecedented scenarios
<ul style="list-style-type: none"> ▪ Stakeholder collaboration 	<ul style="list-style-type: none"> ▪ Pivotal role of seamless coordination across stakeholders ▪ Need for common understanding and unified actions in emergencies
<ul style="list-style-type: none"> ▪ Need for global harmonization of regulations 	<ul style="list-style-type: none"> ▪ Urgency for cohesive regulatory standards worldwide ▪ Benefits of a harmonized approach to Places of Refuge for health crises and other emergencies
<ul style="list-style-type: none"> ▪ Acknowledgement of seafarers, their mental health and well-being 	<ul style="list-style-type: none"> ▪ Critical importance of recognizing seafarers' contributions ▪ Necessity for holistic well-being measures and sustained support
<ul style="list-style-type: none"> ▪ Technological leverage 	<ul style="list-style-type: none"> ▪ Significant role of digitalization in maintaining operational continuity and managing crises

Central to the study's overall recommendations is the call for an industry-wide emphasis on resilience and preparedness, highlighting the critical importance of mental health initiatives, fostering of a robust safety culture, and an unwavering commitment to continuous skill development. At the organizational level, this encompasses standardizing regulatory frameworks across national and international boundaries, and creating a cohesive regulatory environment that supports the free movement and well-being of seafarers. At the control level, it emphasizes the need for shipping companies to invest in cybersecurity infrastructure and personnel training to safeguard against the increasingly sophisticated digital threats. At the individual level, the focus is on enhancing the mental health support systems for seafarers, and recognizing their unparalleled role in maintaining the lifelines of global trade.



The study's findings further underscore the indispensable role of adaptability, preparedness, and effective communication within the maritime sector. The rapid shift to digital documentation and remote management of maritime operations points towards a future where efficiency and resilience are closely interlinked. The study further highlights the significance of seafarers' mental health, advocating for an industry that not only ensures the physical safety of its personnel but also nurtures their psychological well-being.

A key highlight of the study is that confining passengers and crew onboard a ship during a health emergency can lead to complicated humanitarian situations. Places of refuge can offer a more humane alternative, ensuring that individuals have access to basic necessities and appropriate living conditions. Global harmonization of regulations in this regard emerges as a critical imperative.

In summary, this study analysed the challenges posed by the COVID-19 pandemic, shedding light on the safety concerns and risks focusing on the EU maritime and fishing sectors and reflecting on the global industry. It outlines strategic mitigation measures and emphasizes the urgent need for a unified approach to safety and operations not only at the regional level but also global level. By addressing each level's unique challenges, the study's approach ensures that the proposed mitigation measures are practical and relevant to the maritime industry's operational realities.

Proposed risk mitigation actions by key maritime stakeholder groups		
Group	Stakeholder	Risk mitigation actions
Organizational level	Intergovernmental and international organizations	<ul style="list-style-type: none"> Standardise transit and regulatory frameworks for safer global maritime operations Spearhead development of risk assessment tools and promote advanced communication platforms Collaborate on campaigns and initiatives reinforcing safety culture

	Regional regulating bodies	<ul style="list-style-type: none"> ▪ Develop funding initiatives and policy frameworks to further prioritize safety, especially for smaller entities ▪ Foster harmonised seafarer transit policy in collaboration with member states and maritime bodies ▪ Identify and establish precursors of safety issues and emerging risks and maintain close monitoring of their evolution ▪ Standardise operational frameworks for enhanced safety of maritime operations ▪ Spearhead development of risk assessment tools and promote advanced communication platforms ▪ Collaborate on campaigns and initiatives reinforcing safety culture
Control level	Ship owners and operators	<ul style="list-style-type: none"> ▪ Implement comprehensive mental health programs, counselling, and regular check-ins ▪ Allocate resources for safety and maintenance, especially for smaller entities ▪ Invest in cutting-edge cybersecurity solutions and frequent system audits
	Supply chain partners and logistic companies	<ul style="list-style-type: none"> ▪ Diversify supplier networks and foster strategic partnerships ▪ Simulate crisis scenarios to refine response strategies
Individuals level	Crew welfare associations and seafarer support organizations	<ul style="list-style-type: none"> ▪ Drive transparent communication, consistent feedback mechanisms, and welfare initiatives to promote trust ▪ Host safety culture workshops and teamwork enhancement initiatives
	Maritime education and training institutes	<ul style="list-style-type: none"> ▪ Facilitate targeted training programs addressing seafarer behavioural shifts and risk perceptions ▪ Develop onboard drills, ashore refresher courses, and mentorship programs ▪ Host safety culture workshops and teamwork enhancement initiatives

Key findings of the study

This study provides a comprehensive overview of COVID-19's impact on the maritime sector, focusing specifically on safety in shipboard and ship-shore operations relevant to commercial shipping and fisheries. The following points highlight the key findings of the study and puts forward proposed actions:

- **Mental health and well-being of seafarers affects safety:** The pandemic highlighted the critical importance of seafarers and their mental and physical health. Prolonged isolation, stress, and fatigue of crew members might affect the decisions made by the crew and, ultimately may be a factor contributing to marine casualties².

Proposed action: Measures should be taken to develop holistic well-being actions including the provision of crew amenities on board (internet, onboard entertainment, extra recreational equipment, organising special events, arranging extra half-day off, etc.), regular shore leaves, access to medical assistance and update of crew welfare guidance. Typical examples include anonymous periodic well-being surveys to monitor the crew morale, implementation of telehealth services to provide crews with medical advice regardless of the ship's location, and engagement in routine mental health checks.

- **Boosted digitalisation poses new challenges:** The COVID-19 pandemic, with its subsequent global lockdown measures, acted as a catalyst of the digitalisation process in shipping, in particular, in the following areas:

- **Remote inspections/audits:** remote surveys and inspections were implemented as a "rapid adaptation" measure during the pandemic to ensure that mandatory certifications of vessels remained valid. The study highlights the importance of standardising these remote inspection processes and ensuring their validation through subsequent in-person inspections. It is worth noting that the IMO has an agenda item on this topic.

Proposed action: Need for standardising remote inspection processes for ensuring their validation through subsequent in-person inspections.

- **Training:** The pandemic's disruptions pushed shipping companies to shift towards remote training and learning. The abrupt transition to remote learning methods for seafarers during the pandemic may not have been as effective as traditional in-person training, according to some of the answers received.

Proposed action: Remote learning methods for seafarers should be improved to optimise the effectiveness of such training, for instance by developing onboard drills, ashore refresher courses, and mentorship programs. Typical examples include the use of virtual reality (VR) where crew members could simulate various risk scenarios in a virtual environment, enhancing their preparedness for real-world challenges.

- **Cybersecurity:** The increase in digitalisation brought new challenges, including threats to navigation, communication, and overall maritime safety.

Proposed action: More concrete action is needed to mitigate cyber-attacks, like introducing periodic cyber drills simulating real-world hacking scenarios and third-party cybersecurity audits and penetration tests.

- **Decreased attractivity of the shipping sector has a potential impact on safety:** During the pandemics, crew members experienced very negative consequences, including long periods onboard ships due to the difficulty of changing crew, struggle to travel from/to their home countries due to strict airport protocols, lack of medical assistance which produced premature deaths in some cases and mental health problems. All these factors decrease the attractivity of the profession, eroded the trust of the seafarers in the shipping industry and provoked the loss of experienced seafarers. The transfer of critical safety-related knowledge to the next

² This emerged, for instance, in the marine safety investigation following the grounding of M/V "Wakashio" (IMO nr. 9337119) off Mauritius on 25/07/2020 (ref. to Japan Transport Safety Board MA2023-10)

generation becomes compromised (skills gap), potentially leading to a decline in overall safety standards and nuanced decision-making processes.

Proposed action: To counteract trust erosion, efforts like transparent communication, consistent feedback mechanisms, and tangible welfare assurances can serve to rebuild foundational trust. Such efforts could include the rolling out of a digital feedback platform, allowing crew members to provide anonymous feedback on a range of topics, from onboard facilities to safety concerns as such feedback may lead to iterative improvements thus making crew members feel valued and listened to. Other potential actions could be the setting up of a dedicated welfare fund to support crew members facing financial difficulties or emergencies in a bid to boost loyalty and the introduction of long-term incentive program to retain experienced crew and attract new recruits.

- **The pandemic impacted the maintenance of professional skills and competency:** Professional skills degradation is a concern for safety. The pandemic's disruptions, including reduced onboard drills and remote training, potentially compromise situational awareness, task execution, and decision-making. Such issues may be even more intensified by the outflow of skilled workforce, as mentioned above.

Proposed action: The factors identified above suggest the need for a comprehensive approach that integrates retention, mentorship, and continuous training. Retention incentives, paired with mentorship programs, can help in retaining seasoned seafarers, ensuring the seamless transfer of their invaluable expertise. To further counteract the loss of knowledge transfer, structured mentorship programs should be established.

- **Lack of Harmonised Regulations may affect safety:**

- **Travel arrangements:** Disparities in transit travel rights were a matter of concern for seafarers, as they impacted smooth crew changes and repatriation. They encompassed various aspects such as visa requirements and applications, transit visa mandate based on nationality, COVID-19 vaccination requirements, types of vaccines recognised by the country of origin and country of travel, PCR testing protocols and varying hourly validity for travel permissions. Furthermore, the inconsistent acknowledgement of seafarers as key workers, especially outside the EU, became a considerable hurdle. Such inequalities introduce uncertainties and affected crew welfare, triggering anxiety among seafarers.

Proposed action: Measures to achieve a cohesive approach towards standardization, such as a unified seafarer travel policy and standardised implementing guidelines, could assure both operational fluidity and the welfare of seafarers.

- **Port protocols:** The heterogeneous government requirements encompassing COVID-19 vaccination requirements, types of vaccines recognised by the country of origin and country of travel, PCR testing protocols, combined with adherence to quarantine mandates and port closures, intensified the complexities of the operational environment affecting the seafarers' wellbeing and the effective shore-based medical response for ill passengers and crew members.

Proposed action: The above factors suggest that harmonised protocols and common implementing guidelines streamline the decision-making process to deal with health emergencies by national authorities, fostering foster health-related risk management therefore are important to be put in place by the respective authorities.

- **Place of refuge for health emergencies:** In light of the challenges posed by COVID-19, which included confinement of ill passengers and crew on ships, the potential expansion of the "Places of Refuge" concept to also cover health emergencies, such as pandemics, could offer several advantages, including quarantine and medical assistance besides humanitarian consideration, and a coordinated and standardised response.

Proposed action: Standardised safety protocols such as "places of refuge" for ships with human health crisis and enhanced collaborative efforts across the EU contributes to a proactive and resilient maritime framework.

- **Decreased/delayed maintenance can come to the surface in the future:** The disruptions of the pandemic have inevitably introduced delays in maintenance, a concern that literature has previously linked with potential technical and equipment future failures.

Proposed action: Strategic allocation, budgeting, and external partnerships can be effective strategies to maintain crucial areas like maintenance.

Regarding the impact of COVID-19 on fisheries, the study highlighted the following issues and possible mitigation measures:

- **Crew well-being and its safety implications:** The impact of health and safety challenges is inextricably linked to crew well-being, bearing immediate, short-term, and long-term consequences, potentially leading to anxiety, depression, and emotional exhaustion.

Proposed actions: To establish a comprehensive support framework, fostering open communication channels, and providing readily accessible mental health resources. By prioritizing crew resilience and psychological well-being, fishing operations can cultivate an environment conducive to sustained productivity, bolstering the crew's wellness.

- **Qualified labour shortages and safety compromises:** The effects of COVID-19 reflect significantly in the realm of labour availability in the fishing industry, posing a unique set of challenges to both operations and safety. Qualified labour shortages driven by COVID-19 are likely to impose safety risks upon fishing vessel operations, manifesting in potential issues in terms of reduced crew size due to qualified labour shortages, fatigue and developing competence.

Proposed action: The highlighted factors are a call to lay down comprehensive contingency strategies that fisheries should put in place to swiftly address emergent situations, including onboard outbreaks and shortage of skilled crew members.

- **Market fluctuations, financial strain, and safety trade-offs:** COVID-19-induced market fluctuations and financial strain for fishing companies, affecting fishing operations, vessel safety and their crew members. These challenges may encompass effects such as reduction in safety investments and curtail crew training, maintenance, and repairs.

Proposed action: To promote sustainability aimed at securing operativity in uncertain period by integrating sound financial reserves with sustainable practices for protecting marine ecosystems and raising the appeal of seafood products.

- **Delay in inspection and repair and their safety implications:** Fishing vessel operations are heavily reliant on consistent maintenance and timely inspections to ensure the safety of crew members and vessel integrity. The disruptions caused by the COVID-19 pandemic have introduced significant challenges in this regard, leading to delays in inspection and repair activities, especially for large fishing vessels, which, if not properly addressed, may weaken over the long term the company's safety culture.

Proposed action: To allocate adequate safety investments within fishing enterprises, paired with contingency plans, to facilitate access to spare parts, for instance by upholding judicious reserve of critical provisions and diversifying suppliers. Furthermore, dedicated resources for crew training and rigorous maintenance procedures may help in detecting and mitigating safety risks.

In conclusion, the maritime industry is at a critical turning point, and the measures adopted following this study's insights will be instrumental in steering towards a future that, while unpredictable, holds great promise

1. Introduction to the study

1.1 Background

The COVID-19 pandemic resulted in an unprecedented global crisis, affecting nearly every aspect of human society. Among the sectors that grappled with the profound repercussions of the crisis, the maritime transport industry stood as a resilient force in facilitating global trade. The pandemic also ushered a new era for shipping, characterized by shifting trends and a heightened focus on risk management and resilience development.

Shipping operations worldwide have undergone substantial transformations as companies strived to ensure trade continuity amidst the challenges presented by COVID-19 and the ensuing restrictions. From implementing stringent safety procedures within their management systems to adhering to pandemic-related restrictions, both on board and ashore, shipping companies have confronted significant challenges. Similarly, maritime regulators, including maritime administrations, recognized organizations and classification societies, have grappled with fulfilling their obligation to guarantee the safe operation and management of ships, including in the conduct of crucial ship visits, inspections, and audits.

While studies have examined the immediate impact of COVID-19 on maritime safety, the medium and long-term consequences remain largely unexplored. Multiple studies have underscored the prevalence of, among others, fatigue, boredom, anxiety and depression among seafarers during the COVID-19 period, potentially contributing to occupational accidents and other casualties.

Existing casualty databases, by themselves, are currently inadequate for comprehensively assessing the extent of safety hazards in shipping attributed to COVID-19. This is due to some overlooked factors during casualty investigations, which were escalated due to COVID-19, such as extended seafarer contracts and their potential link with routine fatigue and accumulated stress, as well as delayed ship maintenance and its potential link with equipment failures. These elements collectively increase the risk of accidents and incidents, highlighting the need for more comprehensive data analysis.

Therefore, there is an urgent need for a systematic investigation to uncover potential pandemic-related safety issues that may lead to maritime casualties and incidents in the future. Such an investigation would serve to raise awareness of latent threats and provide a holistic understanding of COVID-19's overall impact on maritime safety.

This report represents the culmination of an in-depth study on the potential consequences of the COVID-19 pandemic on maritime safety in the medium and long term.

1.2 Aim and objectives of the study

The objective of this study is to conduct a comprehensive analysis to identify emerging risks and safety issues resulting from the implications of COVID-19 on seafarers and shipping companies. This study seeks to make an original contribution by examining the effects of the potential transition from business as usual to emergency operations, necessitated by the pandemic and its consequent restrictions, on casualties and incidents within the maritime industry in the foreseeable future. Moreover, the study is an attempt to shed light on the resilience demonstrated by companies, the mitigation measures implemented by relevant stakeholders, and the lessons learned from the COVID-19 experience.

By addressing these objectives, this study aims to provide a comprehensive understanding of the implications of COVID-19 on the maritime industry, with a particular emphasis on safety considerations. The findings contribute to the existing body of knowledge, enabling stakeholders to improve their preparedness, response, and resilience in the face of future crises comparable to COVID-19.

1.3 Research questions

To effectively accomplish the aim and objectives of the study, a set of research questions has been formulated, as follows:

- To what extent has COVID-19 resulted in changes to the “normal operations” on board ships, ship-to-shore operations, and shipping companies, and are these new operational practices temporary or permanent in nature?
- What are the potential safety issues and emerging risks that have arisen as a consequence of the operational changes in the maritime industry?
- How have stakeholders addressed the potential safety issues and emerging risks?
- Are the identified safety issues and emerging risks transient, having only affected the phase during which pandemic-related restrictions were in place, or are they likely to persist for an extended period?
- What are the possible precursors or indicators that could facilitate the early identification of the safety issues before they escalate into serious incidents?
- What lessons have different maritime stakeholders learned from their experiences during the COVID-19 pandemic, and how can these lessons enhance resilience against future occurrences similar to COVID-19?

1.4 Scope of the study

This study aimed to identify the changes to "normal operations" experienced by ships and companies as a result of the COVID-19 outbreak. It further sought to assess whether these changes have given rise to potential safety issues or emerging risks that were not evident prior to the pandemic. Additionally, the study examined how stakeholders addressed these issues during the pandemic period.

The scope of the study was limited to the following:

- Cargo ships with a Gross Tonnage (GT) exceeding 500, engaged in international voyages, and that have made port calls in the EU-EEA during the pandemic period;
- Passenger ships involved in international voyages, which made port calls in the EU-EEA during the pandemic period;
- EU-flagged passenger and cargo ships with a GT greater than 500, participating in international voyages, and that have made port calls in non-EU countries during the pandemic period;
- Passenger ships operating in domestic voyages, which made port calls in the EU-EEA during the pandemic period; and
- EU-flagged fishing vessels throughout the pandemic period.

1.5 Period of the study

Defining the temporal scope of this study is essential for understanding the timeframe during which the impact of COVID-19 on maritime safety was evaluated and recognizing the study limitations. The study covered the pre-pandemic period within 1 January 2019 and 11 March 2020; pandemic period starting on 11 March 2020, corresponding to the official pandemic declaration from WHO, until WHO declared COVID-19 over as a global health emergency on 5 May 2023; and, post-pandemic period from 5 May to 30 August 2023.

1.6 Outline of the study report

In the subsequent chapters of this report, the study systematically explores the various aspects of the impact of COVID-19 on maritime safety and the maritime industry response to the pandemic.

Chapter 2 begins by establishing a baseline, examining standard maritime operations. Following this, an overview is provided of previous studies and surveys that have assessed the pandemic's impact on shipping. The study then delves into the multifaceted perspectives of seafarers and shipping companies, extracted through qualitative and quantitative analyses. An in-depth investigation ensues into the emerging risks and potential safety issues stemming from pandemic-induced shifts in maritime operations.

Chapter 3 proceeds with an overview, baseline, and perspectives for identification of emerging risks and potential safety issues, and lessons learnt in the fishing industry.

Chapter 4 reveals best practices derived from stakeholder response to COVID-19, distils crucial lessons learned and proposes strategic mitigation measures, identifying the key stakeholders best suited to implement these actions.

Chapter 5 culminates the exploration by presenting the main conclusions, offering a comprehensive summary of the findings.

1.7 Novelties of this study

This study comprises original research on the impact of COVID-19 on the maritime sector, focusing specifically on safety considering shipboard and ship-shore operations. Most of the existing research look at the economic impact or disruptions to supply chains caused by the pandemic. Furthermore, the existent industry reports and academic studies identified the impact and underlined the magnitude of the impact. Very few studies look into the complete cycle including, the impact, stakeholder's response, and finally the lessons learned. Therefore, this study delves deeper into the challenges faced by seafarers and maritime operators when it comes to safety during these trying times.

In addition to identifying the issues, the study uses pandemic experiences and feedback from the maritime community as a basis to outline the lessons learned. These lessons can help the industry prepare for and better handle future challenges.

Looking ahead, the study provides insights on how the maritime and fishing sector can become more resilient. Given that global crises, whether health, economic, or environmental, tend to recur over time, this forward-thinking approach is crucial. The study offers suggestions to strengthen the industry's ability to deal with future shocks.

Another notable aspect of the study is its examination of the responses of various stakeholders during the pandemic. It looks at the combined and individual efforts of shipping companies, regulators, and others in addressing the pandemic's challenges.

Lastly, the study covers the maritime and fishing industry's experience from before the pandemic, through its peak, and into the period after it ended. This extended period perspective aims to help understand how challenges and responses evolved over time.

Novelties of this COVID-19 study

- Original comprehensive research
- Explicit focus on maritime safety
- Extended time scope covering pre-pandemic, pandemic and post-pandemic period
- Elicitation of changes to normal operations
- Identification of potential safety issues and emerging risks
- Evaluation of the degree of transience of the detected safety issues
- Examples of best practices
- Identification of lessons learned
- Recommendations for resilience

2. Merchant shipping industry

2.1 Identification of the baseline: the “normal”

This study examines the impact of COVID-19 on shipping. Identification of the baseline was a prerequisite to detection of changes brought on by COVID-19.

This section will, therefore, outline the definitions and proceed to introduce and explore the standard operations typically conducted by ships and shipping companies and identify the operations relevant in the context of the study.

2.1.1 Definitions

- **Accident event:** an event that is assessed to be inappropriate and significant in the sequence of events that led to the marine casualty or marine incident.³
- **Baseline:** refers to the standard normal operations and conditions prevalent in the merchant shipping industry before the onset of the COVID-19 pandemic. It serves as a reference point against which changes and disruptions caused by the pandemic are measured and analysed.
- **Casualty event:** a marine casualty or marine incident, or one of a number of connected marine casualties and/or marine incidents forming the overall occurrence.⁴
- **Contributing factor:** a condition that may have contributed to an accident event or worsened its consequence.⁵
- **Designated person ashore (DPA):** a person designated by a shipping company as per Article 4 of the International Safety Management (ISM) Code of the International Maritime Organization (IMO), to ensure the safe operation of a ship and to provide a link between the shipping company and those on board.⁶
- **Domestic voyage:** a voyage in sea areas from a port of a State to the same or another port within that State².
- **Emerging risks:** a new or unforeseen risk that has not yet been contemplated by existing policies, procedures and working practices, and its potential for harm or loss is not fully known.⁷
- **Human resources manager:** a person in charge of the department that deals with the recruitment, training, support, records, etc. of the seafarers employed in the shipping company⁸.
- **International voyage:** a voyage by sea from a port of a State to a port outside that State, or conversely⁹.
- **Marine technical superintendent:** a shore-based technical person assigned by the shipping company, responsible for the safe and efficient operation of the ships in the fleet.
- **Merchant shipping:** the commercial transportation of goods/cargoes and passengers by sea.¹⁰
- **Normal operations:** the standard shipping operations typically conducted by ships and shipping companies, prior to 01 January 2019 including ship and company-related operations relevant to this study.¹¹

³ IMO Res.A.1075(28).

⁴ IMO Res.A.1075(28).

⁵ IMO Res.A.1075(28).

⁶ IMO. The International Safety Management (ISM) Code (as amended 2013 by resolution MSC.353(92)).

⁷ Enterprise Risk Management Initiative. 2017.

⁸ Cambridge Dictionary. 2023.

⁹ European Commission. 2009. Directive 2009/45/EC on safety rules and standards for passenger ships.

¹⁰ Encyclopaedia Britannica. 2023.

¹¹ European Maritime Safety Agency (EMSA). 2022. Tender No. EMSA/OP/8/2022.

- **Onboard operations:** encompass a range of activities conducted by the ships' crew including navigation, cargo handling, ship maintenance and repairs, safety procedures, communications, and activities concerning the compliance with international maritime regulations and obligations.
- **Pandemic period:** the period starting on 11 March 2020, corresponding to the official pandemic declaration from World Health Organisation (WHO)¹², until WHO declared COVID-19 over as a global health emergency on 5 May 2023.¹³
- **Participant:** indicates a respondent, either seafarer or company staff (e.g., managers, DPAs).¹⁴
- **Passenger ship:** for the purposes of this study, refers mainly to Ro-Ro passenger ships, since cruise ship operations were halted during the pandemic.
- **Port services and operations:** refer to the facilities and activities available at ports to facilitate the shipping operations including; loading, unloading, and handling of cargo, drydocking, berthing, facilitation of the provision of ship supply operations, crew change, shore leaves, facilitation of port formalities, communication and activities between ship and shipping agency, communication and activities with port State administration, external audits and inspections, customs and immigration procedures, health procedures, and other logistical support operations.
- **Pre-pandemic period:** the period within 01 January 2019 and 11 March 2020, corresponding to the official pandemic declaration from WHO.¹⁵
- **Questionnaire:** a specifically designed written list of questions that are answered by a number of people so that information can be collected from the answers.¹⁶
- **Safety issue:** an issue that encompasses one or more contributing factors and/or other unsafe conditions.¹⁷
- **Shipping company:** or company, means the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the owner of the ship and who on assuming such responsibility has agreed to take over all the duties and responsibilities imposed by the International Safety Management Code (ISM)¹⁸.

2.1.2 Standard for operations

Maritime operations may be broadly classified under two main categories – operations in the realm of the ship, and operations in the realm of the company. Some operations are not mutually exclusive and require collaborative effort between shore and ship.

¹² WHO. 2020.

¹³ United Nations

¹⁴ European Maritime Safety Agency (EMSA). 2022. Tender No. EMSA/OP/8/2022.

¹⁵ WHO. 2020.

¹⁶ Oxford Dictionary. 2023.

¹⁷ IMO. 2013. Resolution MSC.255(84).

¹⁸ IMO. 1993. International Safety Management Code as amended.

Table 1. Operations in the realm of the ship and company

Operations in the realm of the ship (S)	Operations with collaborative effort	Operations in the realm of the company (C)
Pilotage (S1)	S6	Recruitment and HR management (C1)
Navigation at sea, in port and restricted waters (S2)	S7	Implementation of company's safety culture (C2)
Mooring and anchoring operations (S3)	S8	Policies and procedures (C3)
Embarking/disembarking passengers (S4)	S9	Crew changes (C4)
Cargo operations (S5)	S11	Provision of supplies, spare parts, maintenance and drydocking (C5)
Provision of bunker and supplies (S6)	C2	
Onboard maintenance (S7)	C4	
Conduct of surveys, audits, inspections, and maintenance from third parties (S8)		
Crew changes and repatriation process (S9)		
Conduct of onboard work activities (S10)		
Maintenance of seafarers' rights, health and safety, welfare, and wellbeing (S11)		

2.1.3 Standard for operations in the realm of the ship

The safety of each of the eleven operations (S1-S11 in Table 1) in the realm of the ship, and ship-shore combined efforts, is governed by several potential safety-related parameters that may be susceptible to change due to COVID-19 corresponding to the normal operation. For example, safety of pilotage (S1) depends on the adequacy of pilots in the port, availability of adequate assisting vessels and crew, availability of all necessary information to pilots, availability of senior experienced pilots and crew in the assisting vessels, etc. Together, the identified variables (Table 2) have implications for the safety of normal operations and comprise the standard or baseline of safety-related parameters in the realm of the ship.

Table 2. Safety-related parameters and operations in the realm of the ship

#	Potential safety-related parameters that may be susceptible to change due to COVID-19 corresponding to the normal operation	Standard for operations in the realm of the ship												
		S 1	S 2	S 3	S 4	S 5	S 6	S 7	S 8	S 9	S 10	S 11		
1	Access to communications with family and friends													
2	Access to mental health support													
3	Adequacy of mooring party members													
4	Adequacy of pilots in the port													
5	Adherence to time-schedule													
6	Amount and quality of supervision													
7	Amount of interaction with stevedores													
8	Amount of permissible internet and mobile usage													
9	Amount of supervision by crew													
10	Availability and cost of transportation facilities ashore													
11	Availability and speed of tests and certification													
12	Availability of adequate assisting vessels and crew													
13	Availability of air connections													
14	Availability of all necessary information to pilots													
15	Availability of amenities ashore													

16	Company policy on extension of contract	Green	Orange	Green	Green	Orange
17	Company policy on extension of planned preventive maintenance	Orange	Orange	Green	Orange	Orange
18	Company policy on inventory management	Orange	Orange	Orange	Orange	Green
19	Company policy on maintenance and dry-docking of vessels	Orange	Orange	Orange	Orange	Green
20	Company policy on rate of crew turnover	Green	Orange	Orange	Orange	Orange
21	Company policy on remote training of crew	Orange	Orange	Green	Orange	Orange
22	Company policy on securing dry-dock slots	Orange	Orange	Green	Orange	Orange
23	Company's ability to network with other companies	Green	Orange	Orange	Green	Orange
24	Costs of air travel and accommodation	Green	Orange	Orange	Green	Orange
25	Functioning of foreign embassies and missions	Green	Orange	Orange	Green	Orange
26	Health protocols at ports	Green	Orange	Orange	Green	Orange
27	Health protocols at training institutions	Orange	Green	Orange	Orange	Orange
28	Health protocols of local authorities, home country, and third countries	Green	Orange	Orange	Green	Orange
29	Market availability of spare parts, specialized products, and components	Orange	Orange	Orange	Orange	Green
30	Pandemic status in the seafarer's home country	Green	Orange	Orange	Green	Orange
31	Provision of shore support	Orange	Orange	Orange	Orange	Green
32	Quality of spare parts and components	Orange	Orange	Orange	Orange	Green
33	Seafarers' own free will	Green	Orange	Orange	Orange	Orange
34	Time required for processing of visa applications	Green	Orange	Orange	Green	Orange
35	Trade route of the vessel	Green	Orange	Orange	Green	Orange
36	Type of contract with class surveyors and OEM	Orange	Orange	Orange	Orange	Green
37	Vaccination status of seafarer	Green	Orange	Orange	Green	Orange

Colour scheme	Green	Safety parameter related to operation
	Orange	Safety parameter not related to operation

2.2 Impact of COVID19 on shipping: Overview of the previous studies and surveys

The aim of this section is to provide an overview of previous studies conducted by official entities on the impact of COVID-19 on the shipping industry. In order to comprehensively examine the impact of COVID-19 on the shipping industry, a range of databases were consulted. To reach out the official reports, individual web pages of maritime stakeholders, including the United Nations and its specialized agencies, International Maritime Organization (IMO), European Commission, European Maritime Safety Agency (EMSA), International Chamber of Shipping (ICS), Lloyd's Register (LR), European Community Shipowners' Associations (ECSA), International Transport Workers Federation (ITF). To collect the studies in the academic literature, Web of Science, with its multidisciplinary citation index, and Scopus, known for its extensive collection of peer-reviewed literature, served as primary sources. PubMed, focused on health-related issues, provided essential insights where maritime subjects intersected with health domains. Additionally, Google Scholar was utilized to capture a broader academic spectrum. Within these databases, key search terms like "COVID-19", "shipping", and "maritime" were combined with the name of one of Non-Governmental Organizations (NGOs) or Intergovernmental Organizations (IGOs) recognized by the International Maritime Organization (IMO)¹⁹. Additionally, further research was conducted without specifying NGOs to collect relevant studies beyond the NGO reports.

2.2.1 Overview of official reports

In total, 15 official reports were collected. An overview of each report, consisting of an overview of the main conclusion and related relevant bibliographic information, including the title, the date of publication, the responsible entity of the study and the online access to the document is presented below.

¹⁹ <https://www.imo.org/en/About/Membership/Pages/default.aspx>

Title: [COVID-19 – impact on shipping](#)²⁰

Overview: The European Maritime Safety Agency (EMSA) has been closely observing the influence of COVID-19 on shipping traffic since the pandemic's onset in 2020, releasing a series of analysis reports. By comparing data from different years, the reports evaluate how the pandemic has affected shipping activities, with special emphasis on ship calls at EU ports, operations of ships under EU Member State flags globally, and shipping routes between Europe and major economies like China and the US. The data-driven approach offers a detailed picture of the pandemic's impact in the maritime sector.

Title: [Impact of COVID-19 on the maritime sector in the EU](#)²¹

Overview: This comprehensive analysis by EMSA illuminates the economic impact of the COVID-19 pandemic on the maritime sector across the European Union. Covering areas from maritime traffic to environmental pollution, trade and shipbuilding the report delivers rich insights that outline how these disruptions varied by sector and region. It's a vital resource for policymakers in the EU, offering crucial data to help shape recovery measures aimed at rebuilding the maritime sector post-pandemic.

Title: [The Impact of COVID-19 on Shipping, Seafarers, and Maritime Labour Markets - Lessons learned and practical solutions for the future](#)²²

Overview: The International Chamber of Shipping (ICS) in this research provides an exhaustive look into the repercussions of the pandemic on the shipping industry. It covers the strain on supply chains, the challenges faced by seafarers, and evaluates government and international responses. A significant highlight is the predicament of the many seafarers stranded aboard ships, pointing to a lack of coordination and breaches of International Conventions. The findings reinforce the importance of cross-border collaboration, protection for seafarers, and adherence to global standards.

Title: [Survey on seafarer well-being during the COVID-19 pandemic](#)²³

Overview: In 2022, Lloyd's Register (LR) in partnership with the UK Chamber of Shipping, the Mission to Seafarers (MtS) and Safety at Sea, conducted a survey which delves into the well-being of seafarers during the pandemic. It reveals a dire need for enhanced mental health support for seafarers, with over half feeling ill-equipped to handle stress and fatigue. The survey's findings have spurred industry action, with shipping companies ramping up efforts to aid seafarers' mental health. However, with challenges such as the crew change crisis looming large, the spotlight remains firmly on the treatment of seafarers as essential workers.

Title: [ECSA Survey on Economic Impact of COVID-19 to European Shipping](#)²⁴

Overview: This survey by the European Community Shipowners' Associations (ECSA), in 2020, captures the economic impact of the COVID-19 pandemic on the European shipping industry. It shows that, barring the tanker segment, most of the industry has faced substantial turnover losses. With segments like ferries, cruises, and car carriers particularly hit hard, employment prospects for seafarers in these areas look bleak. The report paints a picture of an industry grappling with the prolonged impact of the pandemic and highlights the need for effective support measures across different areas, from crew changes to financial aid.

²⁰ <https://emsa.europa.eu/newsroom/covid19-impact.html>

²¹ <https://www.emsa.europa.eu/publications/download/6635/4436/23.html>

²² https://www.ics-shipping.org/wp-content/uploads/2022/04/The-Perfect-Storm_HSBA-and-ICS.pdf

²³ <https://www.missiontoseafarers.org/the-sea/far-reaching-impact-of-covid>

²⁴ https://www.ecsa.eu/sites/default/files/publications/ECSA_COVID19_Survey_Report.pdf

Title: [Studying the Impact of Pandemic Outbreaks on Maritime Transportation and Port Operation](#)²⁵

Overview: Undertaken by the Center for Advanced Multimodal Mobility Solutions and Education (CAMMSE), this study assesses the impacts of pandemic outbreaks, especially concerning the maritime transportation sector and port functions. Taking into account disruptions to shipping routes, cargo handling, and more, the study sheds light on the need for agile government responses, flexible protocols, and future contingency measures. The findings underscore the importance of digitalization, modern communication tools, revised sanitary protocols, financial agility, and heightened regional coordination to fortify against future pandemics.

Title: [COVID-19 and Maritime Transport: Impact and Responses](#)²⁶

Overview: An insightful report by the United Nations Conference on Trade and Development (UNCTAD), which examines the immediate ramifications of the pandemic on maritime trade during the first half of 2020. It outlines the multifaceted responses across the maritime supply chain to maintain vital operations, safeguard employees, and ensure the timely transit of essential goods. The analysis presents key takeaways and best practices, intending to bolster the maritime supply chain's resilience against unforeseen disruptions in the future.

Title: [COVID-19 and Maritime Transport - Navigating the Crisis and Lessons Learned](#)²⁷

Overview: This comprehensive report by UNCTAD dives deep into the challenges thrust upon the maritime industry by the COVID-19 pandemic. Beyond identifying disruptions, the study presents crucial lessons to bolster resilience against future crises. Notable observations include the ripple effects of the pandemic on vessel calls, the varied impact on different vessel types, and an upheaval in container services. Emphasising the instability in the entire maritime chain, the report also details how non-pandemic factors, like security concerns and infrastructure inadequacies, were aggravated by the health crisis.

Title: [Impact of COVID-19 on Women in Maritime](#)²⁸

Overview: Commissioned by the Women's International Shipping and Trading Association (WISTA International), this research offers a window into the experiences of women in the maritime industry during the pandemic. Centred around WISTA members, the study reveals that while these women did face the impact of the pandemic, they weathered it better than the global average. The research captures the shift in work dynamics with prolonged work hours, increased domestic responsibilities, and a lasting transition to remote or hybrid work models, even after the easing of pandemic-related constraints.

Title: [Survey on the impact of and response to COVID-19 by IAMU member universities](#)²⁹

Overview: Initiated by the Secretariat of the IAMU, this survey endeavoured to understand the operational ramifications of the COVID-19 pandemic on IAMU member universities. Shedding light on the measures taken to sustain university operations and teaching/learning activities, the survey unveils challenges associated with online learning, especially practical, on-board training programs. Key concerns emanated from the immediate and enduring impacts on university operations, coupled with the influence of public policy decisions on university

²⁵ <https://rosap.ntl.bts.gov/view/dot/64478>

²⁶ https://unctad.org/system/files/official-document/dtltlb2021d1_en.pdf (Produced under Phase I of UN Development Account (UNDA) project on "Transport and trade connectivity in the age of pandemics: Contactless, seamless and collaborative UN solutions".)

²⁷ https://unctad.org/system/files/official-document/tcsdtlinf2022d1_en.pdf (Produced under Phase II of UN Development Account (UNDA) project on "Transport and trade connectivity in the age of pandemics: Contactless, seamless and collaborative UN solutions".)

²⁸ <http://wistainternational.com/wp-content/uploads/8DB5E16E-4CE8-492E-8A5C-AEC02CD255B6.REPORT-Wista.pdf>

²⁹ <http://iamu-edu.org/wp-content/uploads/2020/06/Summary-result-of-the-survey-on-the-impact-of-and-response-to-COVID-19-by-IAMU-member-universities.pdf>

responses. The survey underscores the significance of shared knowledge resources among institutions during unprecedented crises.

Title: [COVID-19 Transport Brief: Lessons from Covid-19 State Support for Maritime](#)³⁰

Overview: Drafted by the International Transport Forum (ITF), this brief scrutinises the State support extended to the maritime shipping industry amidst the COVID-19 outbreak. Despite the wide-ranging challenges faced by the shipping sector, the support rendered by governments was diverse, often lacking specific conditions or alignment with broader policy objectives. The document strongly advocates for a re-evaluation of these support strategies to ensure they resonate with overarching policy goals.

Title: [COVID-19: Impact on Transport in the Arab Region](#)³¹

Overview: Published by the Economic and Social Commission for Western Asia (ESCWA), this study delves into the consequences of the COVID-19 pandemic on the transportation sector within the Arab region. The pandemic's influence has been multifaceted: air transport faced unprecedented adversities, land transport witnessed milder impacts, and maritime freight showcased resilience, albeit with necessary adjustments. The report emphasises actionable policy recommendations tailored to the unique challenges and needs of the transport sectors, especially maritime, in the region.

Title: [The Future of Maritime Safety Report - 2022](#)³²

Overview: Conducted by INMARSAT, this report embarks on a mission to pinpoint primary safety concerns looming over the shipping industry. Using data extracted from Inmarsat's Global Maritime Distress and Safety System (GMDSS) from 2018 to 2021, the study observed a pronounced surge in GMDSS calls during 2020, aligning with the pandemic's apex. Various probable causes for the spike have been identified, including complications related to crew changes, swift port turnovers, and escalating onboard fatigue.

Title: [COVID-19 – Disruptions to U.S. Freight Transportation](#)³³

Overview: The U.S. International Trade Commission (USITC) undertook a comprehensive examination of the ramifications of the COVID-19 pandemic on freight transportation services, particularly on U.S. merchandise imports, in 2020. The study highlighted the challenges encountered by maritime shipping and air freight, from cancelled sailings and flights to notable port delays and container shortages. U.S. imports, predominantly those sourced from Northeast Asia, bore the brunt of these disruptions. The compounded effect of these hindrances and the changing demand dynamics due to the pandemic led to significant volatility in freight rates across regions. The report provides an in-depth insight into the delays and irregularities in the delivery of U.S. merchandise imports during this period.

³⁰ <https://www.itf-oecd.org/sites/default/files/shipping-state-support-covid-19.pdf>

³¹ https://archive.unescwa.org/sites/www.unescwa.org/files/publications/files/impact-covid-19-transport-arab-region-english_0.pdf

³² <https://www.inmarsat.com/en/insights/maritime/2022/the-future-of-maritime-safety-2022.html>

³³ https://www.usitc.gov/research_and_analysis/tradeshifts/2020/special_topic.html

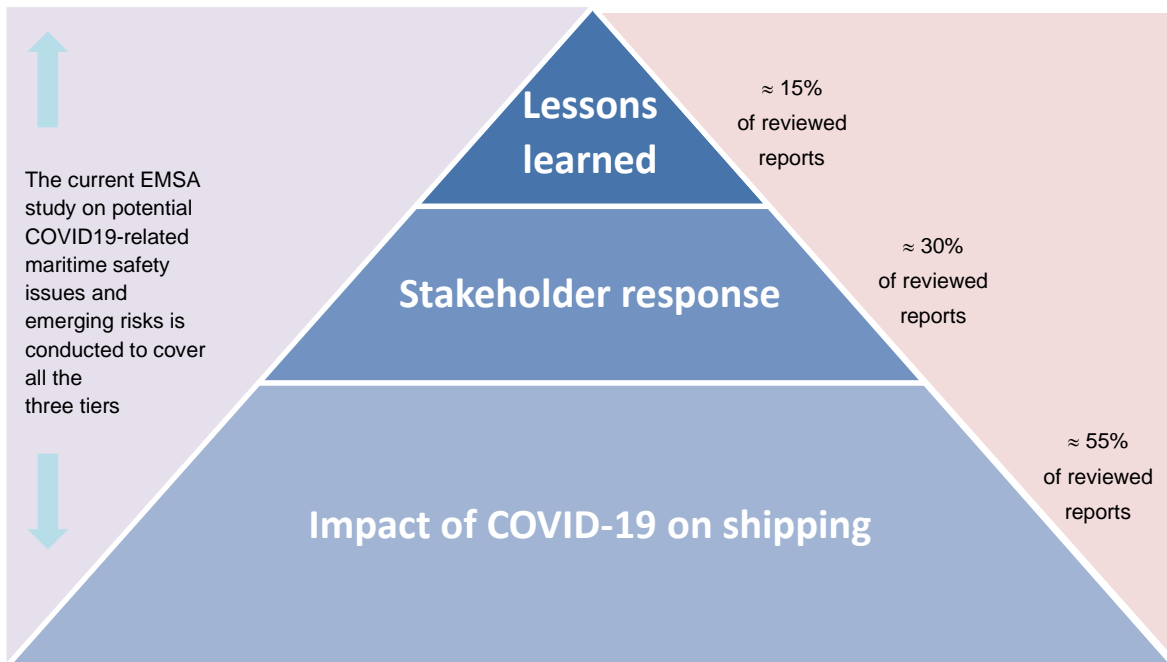
2.2.2 Thematic analysis of the official reports

Broadly, each of the reviewed inter-governmental or non-governmental organisations played their part in enumerating the impacts of COVID-19 on its stakeholders. Additionally, focus was laid on highlighting response measures and lessons learnt while presenting best practices.

More specifically, the main findings from the compiled study reports collectively provide a thorough understanding of the diverse impact of the COVID-19 pandemic on the maritime industry. The thematic analysis of these reports showcases the multifaceted effects of COVID-19 on shipping. These reports, especially those by official entities, primarily discuss the challenges, responses, best practices, and lessons learned associated with the stakeholders. It emerged that the impact of COVID-19 on maritime safety was not significantly highlighted in most official reports, except for those by EMSA. Focusing on safety, EMSA aimed to closely examine the relationship between the pandemic and maritime safety. The study highlighted the maritime safety issues during the pandemic, addressing areas that were previously not accorded due attention. It emphasizes the importance of understanding global events and their effects on the maritime sector. EMSA's study not only reveals new safety issues arising from the pandemic but also guides future research, highlighting the need for a deeper understanding of the challenges in the maritime industry.

A three-tiered schematic of the proportion of studies by organizations addressing the specific aspects of impact, response, and lessons learned is presented in Figure 1. With reference to the thematic distribution pyramid of the reviewed reports, it is important to note that, the current study on potential COVID-19 related maritime safety issues and emerging risks covers all three tiers, from the maritime safety point of view – impact, stakeholder response and lessons learned. Overall, the study aims to achieve a holistic understanding of the pandemic's implications on maritime safety and operations.

Figure 1: Thematic overview of the COVID-19 study reports of organizational entities



A more granular thematic analysis categorizes the primary conclusions of the presented reports into seven distinct themes as presented in Table 4.

Table 4: Thematic analysis of the COVID-19 study reports of organizational entities

Theme	Thematic overview of contribution of organisational entities		
	Impact	Response	Lessons learned
Maritime safety	INMARSAT EMSA LR	EMSA	-
Seafarers' health and well-being	ECSA IAMU ICS ITF LR	IAMU ICS ITF LR	IAMU ICS ITF LR UNCTAD
Academic and educational responses	IAMU	IAMU	IAMU
State and organisational support	ICS ITF LR	ICS ITF LR	ICS ITF LR UNCTAD
Economic and operational disruptions	CAMMSE ECSA EMSA ICS UNCTAD USITC	EMSA ICS UNCTAD USITC	ICS UNCTAD
Gender impact of COVID-19 in maritime context	WISTA	WISTA	WISTA
Regional impact	EMSA ESCWA USITC	EMSA ESCWA USITC	EMSA ESCWA USITC UNCTAD

From the granular analysis at Table 4 it is evident that although maritime safety is at the core of all maritime stakeholders, the impact of COVID-19 on maritime safety is not as frequently addressed as other thematic areas, such as the economic impact or the impact on trade. These themes brought discussions on disruptions, preparedness, vulnerabilities, and responses across the industry. In this study, the emerging theme of safety lays the foundation for the subsequent sections of this report.

2.2.3 Maritime safety across pandemic themes in the academic literature

As emphasized in the previous section, when the study examined official reports on the pandemic's effect on shipping industry, the impact on maritime safety was less frequently addressed compared to other themes. Recognizing this gap, the present study aimed to further investigate the maritime safety theme within the academic literature. By analysing 117 peer-reviewed articles from Web of Science³⁴, the study aimed at understanding more comprehensively what has been covered in academic circles. This exploration will build the foundation for this study. The study thematic analysis of the 117 academic articles shed light on the pandemic's effects on maritime safety across ten distinct themes, as presented in Table 5 and discussed below.

Table 5: Thematic analysis of the COVID-19 study reports of organizational entities

#	Theme
1	Impact on maritime operations and industry
2	Seafarer health and well-being
3	Regulatory changes and compliance
4	Health crisis management and safety measures
5	Port operations and inspection challenges
6	Educational and training adaptations
7	Economic impact and financial strategies
8	Resilience and industry adaptations
9	Need for collaborative efforts and global response
10	Innovative approaches and policy recommendations

³⁴ Web of Science, a widely recognized academic database, provides comprehensive coverage of scholarly articles and research in various fields. It is a valuable resource for accessing peer-reviewed literature and has been used in this study for its reliability and scope.

- **Impact on maritime operations and industry (Theme 1):** Literature highlights that the disturbance caused by the pandemic interrupted maritime operations and industry on a global scale. The industry had to navigate the intricacies of maintaining safety measures while ensuring the continuity of operations in the face of unprecedented disruptions.
- **Seafarer health and wellbeing (Theme 2):** The academic literature extends our comprehension beyond physical aspects to delve into the psychological well-being of seafarers. It emphasises the linkage between wellbeing onboard ships, mental health and maritime safety. The literature accentuates the vital role of the seafarer's well-being and mental health in the broader spectrum of maritime safety.
- **Regulatory changes and compliance (Theme 3):** The literature presents critical examinations of emergent health and safety regulations, emphasising challenges and proposing methods to improve compliance without compromising safety standards. This body of work delves into the intricacies of regulatory adjustments while upholding safety protocols.
- **Health crisis management and safety measures (Theme 4):** The academic literature provides case studies and in-depth analyses of health crisis management strategies. It explores the effectiveness of quarantine protocols, health monitoring, and safety measures in preventing outbreaks on ships, shedding light on successful practices and lessons learned.
- **Port operations and inspection challenges (Theme 5):** Academic research analyses the disruptions in port operations and inspection procedures from a safety perspective. It offers recommendations and strategies for maintaining safety during crew changes and inspections, ensuring that safety remains a priority even in the face of operational challenges.
- **Educational and training adaptations (Theme 6):** The resilience of the maritime industry is reflected in its adaptations in education and training, as illuminated by academic literature, particularly, remote learning practices, including STCW training for deck and engine crew, and shipping companies' training on familiarization and specific operational training (ECDIS, Engine Room Management (ERM), Bridge Resource Management (BRM), cargo operations, watch keeping etc.). It explores how training modules have been adjusted to include safety-focused components, both theoretical and practical, so as to equip seafarers to handle health crises without compromising health protocols.
- **Economic impact and financial strategies (Theme 7):** The maritime industry faced the delicate task of balancing financial strategies with maritime safety requirements. The academic literature explores the synergy between financial strategies and safety imperatives.
- **Resilience and industry adaptations (Theme 8):** The academic literature evaluated the resilience of the maritime industry tested by the COVID-19 crises, and examined how the industry integrated maritime safety measures into their innovative strategies. The literature emphasises safety as a foundational aspect of the maritime industry resilience.
- **Need for collaborative efforts and global response (Theme 9):** In academic discussion, the need for global collaboration and standardised protocols highlighted the centrality of maritime safety. This theme emphasised the importance of not only addressing challenges related to crew changes and international coordination but also ensuring safety across borders. This literature underscores the global nature of safety collaboration.
- **Innovative approaches and policy recommendations (Theme 10):** Innovation emerged as a pivotal theme, and within it, the importance of maritime safety was underscored. Technologies like telehealth and virtual reality offered innovative ways to maintain safety standards and protocols. Academic literature emphasises that innovation should not compromise the industry's commitment to safety.

Figure 2 provides a word cloud, derived from the thematic analysis of the COVID-19 related maritime safety literature. This visual representation emphasizes words based on their frequency of occurrence in the thematic analysis, with the size of each term indicating its significance in comparison to others within the dataset.

distraction, fatigue, and unwillingness to work, particularly among ratings and non-EU member state nationalities. According to a Second Engineer, of North African nationality, *“Compared to my European citizen colleagues, I struggled to join and disembark from my ship because of the visa and transit restrictions.”* A Master and Engineer on a tanker ship’s voices reflect the sentiment shared by many, respectively, *“Our regular work routines were disrupted as contracts were extended. Prolonged time at sea challenged our motivation and mental well-being,”* *“Crew changes turned into a complex puzzle due to travel constraints. I found myself confined to the vessel for an unexpectedly extended duration, leading to a strain on my mental health.”*

Crew changes disruption created challenges for seafarers, affecting the smooth transition of crew members and compromising safety standards, particularly for ships with **batch crew changes**, where the integration of new crew members was hindered by obstacles in familiarization and handovers. As a Chief Engineer from a tanker ship articulated, *“batch crew change in COVID-19 period led to scenarios where more than half of engine room crew members lacked familiarization and understanding of ship machinery. This issue was a major concern during the pandemic, alongside mental health.”* Similarly, another Master from a dry cargo ship said: *“Collective personnel changes can have a negative impact on ship safety due to a lack of familiarization among more than 50% of the crew. Despite attempts to familiarize newcomers, the process was time-consuming and challenging in practice, affecting the safe operations. While risk assessments provided a theoretical framework, sending familiar crew members faced difficulties when put into action.”*

Regarding the **extension of contracts** and prolonged service onboard experienced by a significant number of seafarers³⁵, majority participants suggested of an adverse impact on mental wellbeing of seafarers. As an Engineer said, *“Crew changes became challenging due to travel restrictions and port closures. My contract was extended, and I stayed onboard for extra months due to replacements being unavailable. It led to fatigue among crew members.”*, and a Master added, *“Extensions increased stress and fatigue... fixed contract end dates help maintain focus.”*

Although not mentioned as an issue for EU companies, the emergent need for a larger quantity of spare stocks onboard, as emphasized in the interviews by some masters and chief engineers, the pandemic’s **impact extended into maintenance routines**, mainly due to delays in obtaining spare parts and difficulties in receiving support from onshore skilled personnel. A Master aboard a vessel flagged in EU and operating in EU waters highlighted the enduring challenges in spare parts procurement, stating, *“Unfortunately, the lead times for spare parts remain quite extensive. Even after COVID, the challenges persist.”* The suspension of maintenance activities by many companies during the pandemic resulted in a backlog of work upon the resumption of operations, making effective organization and management a complex task. An Engineer, echoing the sentiment, shed light on the challenges in obtaining spare parts and technical support, saying, *“Access to spare parts and technical support became challenging. Our suppliers faced delivery issues, forcing us to undertake temporary fixes. This increased workload and stress levels.”*

- **Theme 2- Seafarers reflect on well-being challenges during the pandemic:** Amid the pandemic’s challenging times, focus in maritime operations shifted towards the people involved. A Master’s observations indicated how the pandemic caused a unique kind of isolation for seafarers, leading to increased stress, *“Crew members felt stressed about their families, uncertain contracts, and longer stays. This stress led to conflicts and affected how the team worked together.”* Additionally, the longer contracts and physical distancing changed how the crew interacted, as noted by another Master: *“Longer contracts made us tired and tested our patience. The tight spaces sometimes caused disagreements, making it harder for us to work well as a team.”*

The impact of pandemic-related stress was not limited to relationships but also influenced decision-making and teamwork, as an Engineer pointed out, *“Stress and uncertainties made it harder to make good decisions and work together. Overcoming these challenges required us to work together, even though it wasn’t always easy.”* Through the experiences of seafarers, a lot of stories unfold, showing how the pandemic affected crew members’ emotions in maritime operations. The stress caused by isolation and uncertainty impacted crew well-being, but new strategies emerged to help them stay mentally healthy and positive. As the maritime industry faced these human challenges, the stories from Masters and Engineers show how resilient the crew members are and how they tried to evolve their strategies to care for their emotions and mental health.

³⁵ Hebbar, A. A., Mukesh, N. (2020). COVID-19 and seafarers’ rights to shore leave, repatriation and medical assistance: a pilot study. *International Maritime Health* 71(4): 217-228

At the core of these challenges lay the concept of **human experience and resilience**. Trapped onboard the ship without the occasional relief of going ashore, the emotional struggles were profound. A Second Mate mentioned, *“Imagine a world confined to decks and cabins, where the vast sea ironically feels constricting.”* However, amidst this backdrop of monotony and longing, there was the occasional moment of joy and unity. A seafarer recalled, *“Our solace often emerged from those fleeting moments - a shared cheer after completing a task, a meal together, or the spontaneous music of a fellow crew member.”*

- **Theme 3- Seafarers reflect on technological shifts and remote operations:** From remote training methods to digital inspections, interviewed seafarers shared their experiences, offering myriad glimpses into an evolving technological landscape. **Remote training methods assumed a pivotal role**, shifting the training paradigm and brought about the discussion on the effectiveness of the remote options. An Engineer noted, *“Remote training brought convenience, but its impact was as diverse as the crew. Some thrived, while others found motivation elusive in isolation.”*

Furthermore, the pandemic catalysed the rise of **remote vessel monitoring and digital inspections**, reshaping how maritime assessments were conducted. Globally, many of the maritime Administrations and their recognised organizations (both IACS members and non-IACS members) adopted remote surveys and inspections as a “rapid adaptation” measure during the pandemic, as well as the, shipping companies and cargo owners^{36,37}. This was mainly to ensure that mandatory certifications of vessels remained valid without physically having surveyors onboard. The remote inspections extended to statutory surveys, flag State inspections, internal audits, International Safety Management Code audits and port state control (PSC) inspections. Recognised Organizations (ROs) spearheaded these remote activities with flag state approvals when traditional on-board assessments were not feasible. EMSA evaluation of this transition among EU member State’s ROs between 2020 and 2021 highlighted the importance of standardizing these remote inspection processes and ensuring their validation through subsequent in-person inspections³⁸. The interviews reinforce these observations.

A container ship’s Master insights illuminated, “Remote inspections emerged as a novel approach. The digital lens offered insights into vessel conditions, catalysing the evolution of inspections.” This transition towards digital platforms has the potential to streamline operations, enhance efficiency, and provide a deeper understanding of vessel conditions, on the other hand raising issues of **reliability and rigour** as highlighted by nearly sixty percent of senior ship officers who participated in the interviews. As one Master noted, “Remote inspections are efficient, but there’s a temptation to report everything was fine.”

As the maritime industry embraced these remote assessment technologies, a delicate equilibrium between virtual and on-site inspections came into focus. A tanker ship’s Master emphasized this equilibrium, noting, *“The undeniable efficiency of remote assessments needs to be balanced with the accuracy achieved through a combination of methods. On-site audits continue to be indispensable for a comprehensive understanding.”*

In this first-hand experience woven by seafaring professionals, technological adaptation and remote operations stand as a testament to the maritime industry’s resilience. From the multifaceted impact of remote training options to the paradigm shift in ships inspections, the maritime realm ventured into uncharted waters. As technology continues to redefine the industry’s landscape in the post-COVID era, the accounts of interviewees from junior and senior officers, and ratings illuminate both the challenges and the opportunities that lie ahead.

- **Theme 4- Pandemic's influence on seafarers' career perceptions:** Amid the pandemic’s disruptions, more than 40% of the participant seafarers indicated that seafarers were grappling with shifting perceptions of sea careers, pondering the balance between allure and adversity, while the industry’s dynamics underwent profound scrutiny. The pandemic’s impact on maritime careers was profound, reshaping how they were perceived. A tanker ship Engineer’s observation resonates deeply, *“The pandemic made a career at sea less*

³⁶ <https://www.dnv.com/news/imo-iii-9-guidance-on-remote-survey-and-ism-code-audits-finalized-247223>

³⁷ https://www.ocimf.org/doclink/afm-remote-inspections-factsheet/eyJ0eXAiOiJKV1QiLCJhbGciOiJIUzI1NiJ9.eyJzdWUiOiJhZm00cmVtb3RILWluc3BIY3Rpb25zLWZyY3RzaGVldCIsImh0dCI6MTYzMDkyNDMzNywiZXhwIjoxNjM3fQ.kBrhfQd-p_T3l_GD9T3SangiJN6hMpwtnRuQmOAaXew#:~:text=Remote%20inspections%20are%20being%20offered,deemed%20by%20a%20submitting%20company.

³⁸ EMSA. (2022). The European Maritime Safety Report (EMSAFE) 2022. European Maritime Safety Agency (EMSA). <https://emsa.europa.eu/publications/item/4735-emsafe-report.html>

attractive. Uncertainty surrounding crew changes and extended contracts have made seafaring a less appealing option.”

The shift in perception suggests that the pandemic has prompted seafarers to re-evaluate the trade-offs and challenges associated with their chosen profession. A dry cargo ship Master holding EU member state citizenship emphasized, *“Many experienced seafarers are considering land-based jobs due to various factors, including the pandemic and the challenges of being at sea.”* This insight underscores the growing tension between the allure of maritime careers and the practical considerations arising from the pandemic’s disruptions. In this climate, the pandemic has become a litmus test for the industry’s appeal, particularly when it comes to work-life balance, shore-leaves, job security, and compensation. A container ship Master holding EU citizenship shared his perspective on his shift to the offshore sector during COVID-19, *“Overall, I’m satisfied with my move to the offshore sector. The work-life balance, security, and supportive company culture make it a good choice for me.”* His experience showcases the nuanced interplay between personal fulfilment and industry dynamics, where factors beyond the job description come into play.

On the other hand, a passenger ship Master emphasized the complex nature of maritime careers, stating, *“The sea is both challenging and rewarding. If you have a passion for it, embrace the changes, be prepared for the highs and lows.”* Through the words of seafarers, shifting perceptions, decisions, and aspirations unfurls.

- **Theme 5- Seafarer's perspective on pandemic policy adjustments:** The COVID-19 pandemic served as a **litmus test for the maritime industry’s long-standing policies**, prompting rapid adaptations and innovative solutions to ensure the safety and well-being of crew members while upholding operational integrity.

Seafarers’ experiences offer a window into the challenges and adaptive strategies European companies employed. For instance, while discussing his company’s approach, the Master mentions, *“Yes, my current company has been proactive in maintaining safety and crew well-being, compared to my previous company [in non-EU country].”* This reflects a responsive approach by EU companies, where the focus shifted from merely adhering to policies to adapting them to the pandemic situation based on real-time feedback.

The pandemic also brought into focus how **changes in policies regarding crew welfare** were approached. While shore leave, healthcare access, and crew changes might seem like logistical challenges, they touch the core of crew well-being and morale. The restrictions imposed by various ports, including the European ports, combined with the heightened risk of the virus, meant that companies had to redefine these procedures without compromising on crew rights or health.

Although IMO urged governments to **recognise seafarers as key workers** to facilitate their movement, wide implementation was lacking. A seafarer said, *“While I understand the intention behind IMO’s initiative to call seafarers as key workers, it can’t help but I feel that it’s just symbolic without much concrete change. We’ve been facing challenges even before the pandemic, from long working hours to issues with crew change and shore leave. The recognition is nice, but what we really need is tangible support. Calling us ‘key workers’ won’t magically solve the problems we’ve been facing. We need governments and companies to step up and address the issues affecting us, like fair treatment, better working conditions, and improved access to medical care. It’s time that actions matched words.”*

It has been also highlighted by a number of interviewed seafarers that **unharmonized regulations and unequal treatment** based on nationality, even in EU member State ports, create a tough situation for seafarers’ movement globally and other psychological issues. Different rules at different ports lead to confusion, delays, and added stress during crew changes. A Master from a non-EU flagged ship explains, *“Every port has its own rules. It’s like navigating through a maze.”* He adds, *“Seafarers often face inconsistent visa processes, health screenings, and different quarantine rules, making their transit unpredictable.”* Especially during global health emergencies or other outbreaks, the necessity of designated places of refuge for purposes of health becomes even more crucial. A Rating Seafarer commented, *“I’ve seen colleagues turned away because of where they’re from. It’s not fair.”* Unequal treatment can mean limited access to services and unequal rights. This disparity not only affects morale and job satisfaction among seafarers but also underscores the importance of having standardized procedures and places of refuge. As highlighted by a Master of a passenger ship, *“Standardizing rules and treating all seafarers fairly will ensure smoother operations and better seafarer well-being”.*

- **Theme 6- Seafarers' perspective on training evolution and skill development:** Another significant issue highlighted by Masters and Chief Engineers revolves around the training and competency of the new generation of seafarers. During COVID-19, **remote training methods gained importance** with increasing demand to meet the training requirements. However, its implementation comes with challenges in sustaining engagement and effectiveness, a point highlighted by a Chief Engineer, *“Remote trainings were conducted, but their effectiveness varied based on the interest of individuals.”* A Seafarer added, *“Online training during COVID-19 has been helpful, but it’s like reading about swimming without actually diving into the water. Practical experience matters more.”*

Additionally, it was emphasized by the participants that the cancellation of onboard drills and the halt in activities aboard passenger ships have been detrimental to **practical skill retention**. A passenger ship Master said, *“With onboard drills cancelled and ship activities stopped, hands-on skills suffered.”* He added, *“the absence of hands-on practice impacts seafarers’ ability to perform effectively in critical situations, especially on passenger ships.”*

Another issue that was highlighted related to the **skill development and knowledge transfer** is the **early lateral shift of experienced seafarers** namely, early retirement and shift to a shore-based occupation. The early exit of experienced seafarers can be linked to shifts in career preferences, as an Engineer stated, *“The pandemic made a career at sea less attractive. Uncertainty surrounding crew changes and extended contracts have made seafaring a less appealing option.”* The departure of seasoned crew members raises concerns about the loss of valuable expertise and practical insights from the maritime industry. A number of Masters and Chief Engineers of EU and non-EU flagged ships agreed that the departure of experienced seafarers due to the pandemic can create a significant knowledge transfer gap, where the absence of seasoned crew members aboard means less mentorship and less practical guidance for newcomers.

- **Theme 7- Seafarers reflect on collaboration and communication challenges:** COVID-19 dramatically **disrupted traditional channels of communication**. Crew members, who once enjoyed the advantage of direct communication with each other and with the onshore team, suddenly found themselves grappling with **technology-mediated interactions**. As a Master commented, *“Remote trainings were conducted, but their effectiveness varied based on the individuals. Some took it seriously, while others didn’t. As for monitoring, some inspections became online meetings, but for effectiveness, I prefer when they come on board to see the actual conditions.”* This statement captures the contrast that became evident during this period: the inevitable push for remote operations versus the tangible benefits of in-person interactions.

Moreover, the changes were not merely restricted to ship-to-shore communications. Onboard collaborations also experienced strain. With crew members being at sea for extended periods due to delayed crew changes, there was a heightened sense of isolation. This impacted the **dynamics of teamwork on ships**, especially given the absence of fresh perspectives from new team members, as highlighted by over a third of the interviewed seafarers.

Another pivotal aspect frequently referred to in the interviews was the efficiency of operations that traditionally relied on physical interactions. For instance, roles such as pilotage, lashing, and other on-board assistance from shore personnel became challenging.

The pandemic underscored the maritime industry’s reliance on effective communication and collaboration. The abrupt shift to remote operations is likely to unveil vulnerabilities in the system, reiterating the value of human interactions in the complex world of shipping.

Quantitative overview of the expressed concerns of the interviewed seafarers

Following the thematic analysis of the interviews with seafarers, Figure 3 presents a quantification of specific issues based on mentions during the interviews and intends to shed light on any issues that might not have been explicitly highlighted in the initial thematic exploration. For example, 83% of seafarers working on dry cargo vessels mentioned that delayed crew changes and long quarantine periods are the most significant concern.

Figure 3: Areas of concern of seafarers

Areas	Container	Dry cargo	Tanker	Passenger
Delayed crew change and long quarantine periods	83%	83%	50%	13%
Batch crew changes, reduced familiarization	67%	50%	19%	13%
Remote trainings, reduced practical knowledge/skills	33%	43%	25%	50%
Cargo operations within Covid-19 restrictions (stowage, securing and lashing)	67%	17%	13%	5%
Reduced work-life balance, wellbeing on board	67%	67%	25%	25%
Reduced attractiveness of sea career, impact on career choices	42%	33%	25%	8%
Provision supplies quality and frequency reduction	33%	25%	25%	13%
Limited access to healthcare services onshore	67%	17%	13%	3%
Workload and fatigue	50%	42%	13%	40%
Unavailability of spares and equipment supply	33%	33%	25%	25%
Efficient inspection with remote options	35%	33%	45%	33%
Passenger operations, hygiene and physical distance	0%	0%	0%	75%

2.3.1.2 Shipping company interview outcomes

To represent the shipping companies' perspective in a reliable manner sixty-one persons have been interviewed from different companies comprising designated persons ashore, technical superintendents and human resource managers owning and/or managing dry cargo, tanker, container and passenger fleets. By tapping into the personal narratives and perspectives of these maritime professionals, a spectrum of five underlying themes emerges, each capturing a distinct facet of the pandemic's influence on maritime operations. Collectively, these themes unveil the multifaceted dynamics of the industry's response to the pandemic.

- Theme 1- Navigating the operational disruptions and adaptation:** The interviews conducted with shipping company staff illuminated the significant operational challenges that the COVID-19 pandemic unleashed upon the maritime industry. The impact of the crisis was both profound and unexpected, catching many shipping companies off guard and leading to disruptions in established routines and procedures, both onboard and ashore.

The sentiment that the industry was ill-prepared to face such an unprecedented disruption was palpable, as an HR Manager pointed out, *“The pandemic was a big surprise, causing global supply chains to stop and showing that most of the shipping companies weren't ready.”* This acknowledgement underscores the vulnerability of the maritime sector and the need for enhanced readiness to mitigate future crises.

The sudden and unforeseen nature of the pandemic necessitated swift adaptations in response to rapidly changing circumstances. Both onboard and ashore, shipping companies grappled with unforeseen challenges that demanded creative solutions. In the context of crew changes, for instance, an HR Manager shared, *“Crew changes became a logistical nightmare with travel restrictions and port closures. Our crew members were stranded on vessels for extended periods,”* highlighting the cascading effect of the disruption and its impact on crew rotations.

From a technical standpoint, the operational challenges extended to ship maintenance and provision supply. While a few shipping companies in the EU were proactive in maintaining additional stocks of spare parts on board, as indicated by their technical staff, delays in spare parts procurement and maintenance interventions were experienced by many companies due to supply chain disruptions, particularly from the suppliers based in Asia. As a Technical Superintendent shared, *“Getting spare parts on time became a struggle, and we had to come up with alternative solutions to keep the ships operational.”* This underscores the direct impact of global supply chain disruptions on ship's maintenance and operational continuity.

Therefore, shipping companies were prompted to explore innovative ways to ensure business continuity caused by the logistical challenges of maritime operations. In this respect, an HR Manager commented, *“Shifting from business as usual to emergency practices required creative thinking. We had to adapt procedures quickly. It was a learning experience for everyone...”* In this vein, technology emerged as a crucial enabler. *“Technology was a key player in tackling the operational hurdles. Working remotely and connecting virtually became the way of doing things, enabling us to keep communication and operations going, at least to a certain degree.”* observed a Technical Manager.

This adaptive mindset extended beyond remote work policies, as organizations needed to restructure their operations to incorporate risk-based approaches. This strategy aimed to ensure safety while maintaining operational continuity. Organizations were compelled to re-evaluate their strategies and plans, ensuring they could continue to operate under unforeseen circumstances. Many companies introduced temporary changes in response to governmental and EU regulations, such as quarantine and social distancing measures.

As the maritime industry navigated this evolving landscape, a "new normal" began to take shape, as a DPA conveyed, *"the industry began to establish novel ways of operating that would likely influence our future practices"*. With the challenges brought about by COVID-19, there was a marked shift towards e-learning platforms and virtual training sessions. The rise of Virtual Reality (VR) and Augmented Reality (AR)³⁹ has meant that these remote training sessions could provide a nearly realistic experience without necessitating the trainee's physical presence; however, standardization, harmonization and the efficiency in practical training remains a matter of concern.

Similarly, in respect of audits, instead of auditors traveling to ships or facilities, the industry began leveraging technology such as video conferencing and document sharing for remote audits. Some innovative companies have even taken to deploying drones for visual inspections of vessels⁴⁰.

Additionally, the recruitment landscape within the maritime sector has also witnessed a digital evolution. The entire process, from applications to interviews and document verification, has shifted online.

Last but not the least, a profound change in the Harbour Masters office has been the pivot from traditional paperwork to digital documentation for seafarers' documents and digitalized crew certifications.

In conclusion, the interviews, in this essence, revealed a shared paramount importance of adaptability and flexibility in maritime operations, underscoring the critical need for robust contingency planning, proactive strategies, and innovative solutions to mitigate the impact of unforeseen disruptions such as the COVID-19 outbreak.

- **Theme 2- Managing crewing challenges and well-being:** The far-reaching impacts of the COVID-19 pandemic profoundly affected seafarers, giving rise to a wide range of challenges that encompassed not just logistical concerns like crew changes but also crucial matters such as crew well-being. A central issue that emerged was the complexity surrounding crew changes, particularly resonant for non-EU citizen crew members from amongst the major maritime labour supplying countries. As illuminated by a HR Manager, *"Crew change was a formidable hurdle, particularly for our non-EU citizen crew members, entailing struggles in securing flights and navigating evolving quarantine regulations..."*, and supported by another HR Manager, *"The complexity of crew members' repatriation was amplified by divergent restrictions across different nations. Variability in testing requirements and schedules aggravated the difficulties."*

Collaboration between shipping companies, port authorities, and governmental agencies played a pivotal role in facilitating crew changes despite the numerous restrictions, as a DPA noted, *"Safeguarding our crew's safety remains our overriding priority. We collaborated closely with port authorities and governmental agencies to facilitate crew changes despite the numerous restrictions."*

The difficulties inherent in crew change and repatriation during the pandemic further exacerbated the challenges faced by seafarers. The strict COVID-19 restrictions imposed by various countries, coupled with a lack of flexibility during the initial pandemic period from late 2019 to mid-2021, presented monumental hurdles in the planning and execution of crew changes. This was echoed by 80% of the HR Managers who participated in the interviews, underlining the gravity of the issue. The outcome was prolonged contracts, with durations up to 2-3 times the usual length, imposing additional stress, anxiety and fatigue on the crew while intensifying the operational pressure on HR personnel; as noted by an HR manager, *"Prolonged durations onboard exacted a toll on crew members' mental and emotional well-being. The inability to disembark and connect with their families exacerbated the strain."*

³⁹ <https://www.kongsberg.com/digital/resources/news-archive/2019/australian-maritime-college-and-kongsberg-eye-potential-for-vr-training-with-renewed-support-program2/>

⁴⁰ DNV. (2023). The drone squad for ship surveys. <https://www.dnv.com/expert-story/maritime-impact/The-drone-squad-for-ship-surveys.html>

Efforts to address various challenges related to crew change and well-being were visible through remote mental health and well-being support services, offered via telephone and the internet by shipping companies and third-party professionals. For instance, remote medical assistance was implemented by most of the shipping companies to compensate for the lack of access to shore medical services, and as one HR Manager, among many others, reported: *“The real challenge was providing medical assistance ashore. Remote medical consultations became more common, which, although not ideal, was a way to address some health concerns. We tried our best to ensure that our seafarers had uninterrupted telemedical support.”* While considered beneficial by some seafarers, concerns regarding the efficiency and efficacy of these remote services were raised by a third of the HR Managers who participated in the interviews. In addition to remote medical assistance, onboard wellness campaigns were implemented, with senior crew members assigned as wellness coaches, resulting in improved crew morale and a more positive atmosphere. Nonetheless, the challenge of maintaining effective communication between seafarers and their families remained a consistent concern during COVID-19 period, which frequently brought the seafarers to the attention of HR Managers and DPAs.

However, the absence of standardized procedures, as countries grappled with varying quarantine requirements and operating protocols in the pandemic's initial 12-month period, further complicated crew changes, making effective planning an elusive goal, as stressed by more than half of the DPAs interviewed in this study. The unpredictability of crew changes due to last-minute cancellations prompted by positive PCR tests added a layer of uncertainty and upheaval, affecting planned operations, as indicated by several interviewees.

In conclusion, the interviews highlight the vital significance of prioritizing crew well-being within the complex maritime operations landscape. Collaborative measures to enable crew changes and provide mental health support have played a crucial role in alleviating the pandemic's adverse effects on seafarers' physical and mental health. These findings are poised to guide future strategies aimed at upholding crew welfare and operational stability in the face of unexpected disruptions.

- **Theme 3- Exploring technological solutions to ensure continuity:** In response to the challenges posed by the pandemic, the maritime industry swiftly embraced technological solutions, most notably in the realm of remote operations. These encompassed areas such as remote audits, surveys, and training, which helped in streamlining processes, reducing costs, and maintaining some level of operational continuity and readiness.

The transition to remote surveys, as highlighted by a Technical Manager, *“We've started using more remote surveys when possible. It's easier, faster, and cheaper,”* wasn't without its hurdles. It required meticulous planning and coordination between ship and shore. Moreover, not every type of survey is conducive to a remote format. As companies navigated these waters, they had to assess the feasibility of remote surveys based on the specific context of each vessel and survey type. Offering a comparative perspective, a Technical Manager from a large European shipping company stated, *“A remote survey costs about an average €700. If you have a surveyor coming on board, it's close to double. The actual time for the survey remains the same, but it's easier to organize.”*

Beyond the scope of remote surveys and inspections, the maritime industry also realized the potential of technology in crew training. Online training programs gained traction, enabling crew members to update their knowledge and achieve certifications while respecting physical distancing guidelines. As agreed by 25% of the interviewees, for basic familiarization and theoretical knowledge required by international standards (i.e., STCW Convention), online training proved effective, ensuring compliance, operational continuity, and also providing time and cost savings.

Virtual communication tools, such as emails, phone calls, and video conferencing, proved to be indispensable lifelines during these challenging times. They not only facilitated operational dialogues but also became the mainstay for morale and well-being of ship crews. Given the prolonged periods at sea, these platforms provided an essential connection to family and relatives ashore, mitigating feelings of isolation. Additionally, they became conduits for telemedical services, linking seafarers with third-party health professionals, ensuring their well-being amidst the global crisis.

The maritime industry's technological transformation, catalysed by the pandemic, wasn't without challenges. The primary hurdles associated with remote operations, especially surveys and inspections, revolved around their reliability. As a DPA rightly pointed out, *“...remote inspections have their limitations in seeing the full picture...”* This sentiment resonated with a Technical Superintendent's observation, *“We had several times that we overlooked the non-conformities and observations in remote audits and inspections which were later*

revealed during port state control inspections.” Such challenges underscore the importance of a blended approach, balancing the conveniences of technology with the precision of in-person evaluations.

Furthermore, while HR and technical staff from shipping companies saw merit in remote training, Chief Engineers and Masters voiced concerns regarding the diminishing practical skills due to a lack of hands-on training. They also spotlighted the potential pitfalls of excessive use of the internet, social media, and phones on board. While these technological avenues offered a semblance of normalcy and connection, they sometimes led to distractions, fatigue, and added stress, particularly when seafarers were exposed to distressing news from the shore, especially concerning loved ones affected by COVID-19.

In conclusion, the interviewees commonly agreed on the fact that the pandemic acted as a pivotal turning point, pushing the maritime industry towards a more technologically integrated future. Remote surveys, online training, and digital communication tools were at the forefront of this shift, playing a crucial role in ensuring operational continuity while emphasizing safety. The learnings from this COVID-19 experience will undoubtedly shape the industry's approach to technology and innovation in the future.

- **Theme 4- Navigating policy and regulatory implications:** Policies and regulations played a pivotal role in shaping maritime operations amid the challenges of the COVID-19 pandemic. Regulatory modifications and harmonization initiatives within the maritime industry had consequential effects on daily maritime activities.

The interviews underscored the significant impact of policy and regulatory changes on maritime operations. Interviewed DPAs emphasized that regulations surrounding crew changes and port operations were instrumental in shaping their response to the pandemic. Government requirements for individuals, including shipping company staff and ship crew members, to possess negative COVID-19 tests or/and vaccination certificates, combined with adherence to quarantine mandates, intensified the complexities of the operational environment.

All participating DPAs highlighted that travel restrictions and port closures led to significant delays in crew changes and disrupted cargo operations and passenger transport. One DPA remarked, *“The new government rules, like travel restrictions, needing negative COVID tests or vaccine proof, really messed with our usual way of doing things. Quarantine rules added another layer. It all changed how we managed crew change and operations at ports during COVID.”*

Furthermore, the interviews touched on the importance of collaboration and communication during these challenging times. Several participants discussed working closely with port authorities, maritime authorities, and government agencies to adapt to the new regulatory landscape. A DPA pointed out that, *“the pandemic highlighted the importance of constant communication with regulatory bodies. Clear and timely communication is crucial to understand and adapt to new changes to regulations.”*

The challenges were particularly pronounced for European-flagged ships that sailed to destinations outside of Europe, as well as those crewed by non-EU citizen seafarers. These ships faced an added layer of complexity, needing to navigate both the regulations of their home countries and the diverse requirements of non-European ports. A significant concern, in this context, raised during the interviews was the inconsistent recognition of seafarers as key workers, especially outside the EU. While some countries acknowledged the crucial role of seafarers and categorized them as essential personnel, others did not. This inconsistency led to additional challenges, particularly when ships docked in countries that did not recognize seafarers as key workers. The lack of recognition meant seafarers faced more stringent restrictions, which further complicated operations during the pandemic. One HR Manager said that, *“the inconsistent acknowledgement of seafarers as key workers, especially outside the EU, became a considerable hurdle, and showed the varying levels of appreciation for seafarers’ roles in the global trade.”*

Harmonization of efforts emerged as a focal point of the interviews under this theme, with several participants stressing the need for standardized regulations across countries. A Technical Manager of a European shipping company emphasized, *“Harmonization of regulations within the European Union is crucial, and standardized regulations would greatly simplify operations and ensure compliance.”* Similarly, a DPA from a large European shipping company underscored the benefits of a unified system, stressing the importance of consistent COVID-19 testing and quarantine procedures not just across Europe but ideally worldwide. Such standardization would streamline operations and eliminate the ambiguities introduced by varying regulations. Another HR Manager echoed this sentiment, pointing out the difficulties posed by diverse COVID-19 related testing and quarantine

protocols in different countries, and the lack of uniformity in these requirements, especially complicated operations that required human mobility and interaction. On a related note, the absence of a “place of refuge” concept for health issues further complicates the global response and coordinated efforts.

In short, the interviewees’ insights from the pandemic experience underscored the maritime industry’s urgent need for unified regulations, clear communication, and flexibility. These elements are vital not only for safety, but also to ensure smooth operations in challenging times.

- Theme 5- Unpacking experiences and reinforcing resilience:** The maritime industry faced a slew of challenges during the COVID-19 pandemic. These challenges led shipping companies, both in Europe and beyond, to deeply re-evaluate their operational practices, contingency strategies, and overall approach. An HR representative aptly captured the essence of this introspection, stating, *“We learned a lot and if something like this happens again, we’ll be much better prepared and react quicker on certain things.”* This sentiment epitomizes the industry’s overarching move towards increased adaptability, with an emphasis on safeguarding crew welfare and ensuring smooth ship operations.

Within the context of the pandemic, shipping companies embarked on a journey of self-reflection, identifying gaps in their policies, practices, and strategies. Based on the accounts of technical and human resource personnel interviewed, there was a clear consensus on the urgent need for agility and the swift implementation of responsive measures. Several lessons emerged, including the creation of harmonized “COVID protocols”, the necessity for stockpiling critical spares, and the establishment of robust pandemic health-related risk management frameworks. Furthermore, the value of swift decision-making, often in collaboration with other stakeholders, was underscored. As a DPA indicated, challenges were inevitable, but the way companies managed them, particularly through collaborative efforts, made a significant difference.

The shared reflections of interviewees provided a window into the collective wisdom gained during the COVID-19 period. While DPAs frequently stressed the need for flexibility in adapting to unforeseen events, HR Managers spotlighted the imperatives of business continuity and the global mobility and well-being of seafarers. A HR Manager remarked, *“After everything we went through during the pandemic, we had to redesign our approach to disruptions... Now, I believe we have a more resilient blueprint for various challenges.”*

Collaboration emerged as a golden thread in the discussions. The importance of synergies, particularly with maritime authorities and industry stakeholders, was a recurring issue. A Technical Manager shared, *“Because of the pandemic, we learned that adaptability and collaboration, especially with maritime authorities and other stakeholders, became more crucial than ever before.”*

However, the insights derived from the pandemic are not just retrospective; they are shaping the future. Companies reported that they are channelling these lessons, ensuring they inform strategic planning moving forward. As one DPA confirmed, *“We realized the value of adaptability... it’s about being equipped for the unforeseen and adjusting our sails as needed.”*

In a nutshell, as reflected in the interviewees’ insights, the maritime industry has turned its challenges from the COVID-19 pandemic into substantial lessons. These experiences and lessons should not only equip the industry to withstand future outbreaks similar to COVID-19 but also guide it toward a more informed and resilient path for the future.

Quantitative overview of the reflections of shipping company personnel

Following the thematic analysis of interviews, Figure 4 presents a quantitative overview of specific issues derived from the mentions during the interviews to further elucidate any issues that might not have been explicitly underlined in the primary thematic exploration.

Figure 4: Areas of concerns of shipping company staff

Areas	Shipping company personnel
Immobility and fleet safety management	66%
Reliability of inspection with remote options	43%
Maintenance and dry docking during lockdowns and restrictions	33%
Difficulties in communication and stakeholder relations	69%
Increased workload of company staff	82%
Issues related to readiness to embrace evolving technology (remote options)	52%
Difficulties in crew change and repatriation	95%
Reported deterioration of crew wellbeing	33%
Difficulties in providing access to healthcare services onshore	36%
Reduced attractiveness of sea career and crew retention	16%
Issues related to unharmonized regulations and policies	38%
Effectiveness of online training	25%
Insights on seafarers stress and fatigue	74%

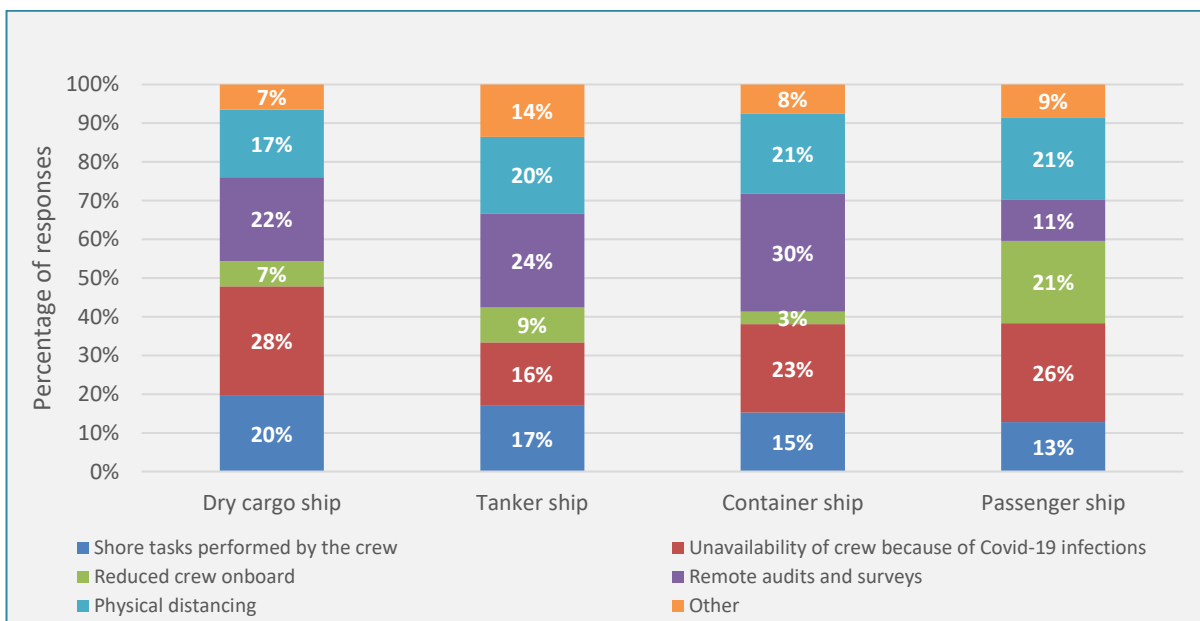
2.3.2 Results of the questionnaire survey

Building on the insights gained from the interviews, the study further delved into the repercussions of COVID-19 on normal operations, its induced changes, and effects on facets such as seafarers' workload, stress and anxiety, work performance, enforcement of safety standards, and support extended by shipping companies and governments. To this end, a survey questionnaire (see Annex) was formulated, comprising of thirteen questions. The scope of the participation was limited to seafarers who operated on EU-flagged ships or worked onboard ships that called in the EU ports. In total, 370 completed questionnaires were received (see Annex). The results, which are discussed below, offer insights into the changes in normal operations, as well as the challenges and experiences of seafarers during the COVID-19 pandemic.

Sources of additional workload during COVID-19

During the COVID-19 pandemic, various ship types experienced different primary sources of additional workload, as revealed by the results of the study survey. Dry cargo ships and passenger ships were most impacted by availability of crew onboard (i.e., reduced crew or crew unavailability due to COVID-19 infections/other illnesses) at 35% and 47%, respectively. Tanker and container ships struggled the most with additional workload caused by remote audits and surveys, with respectively 24% and 30% reporting it as a significant concern. Notably, passenger ships had the highest percentage of workload increase from reduced crew onboard, standing at 21%. These findings highlight the distinct challenges each ship type faced, emphasising the need for tailored solutions to address their unique operational hurdles during the pandemic (Figure 5).

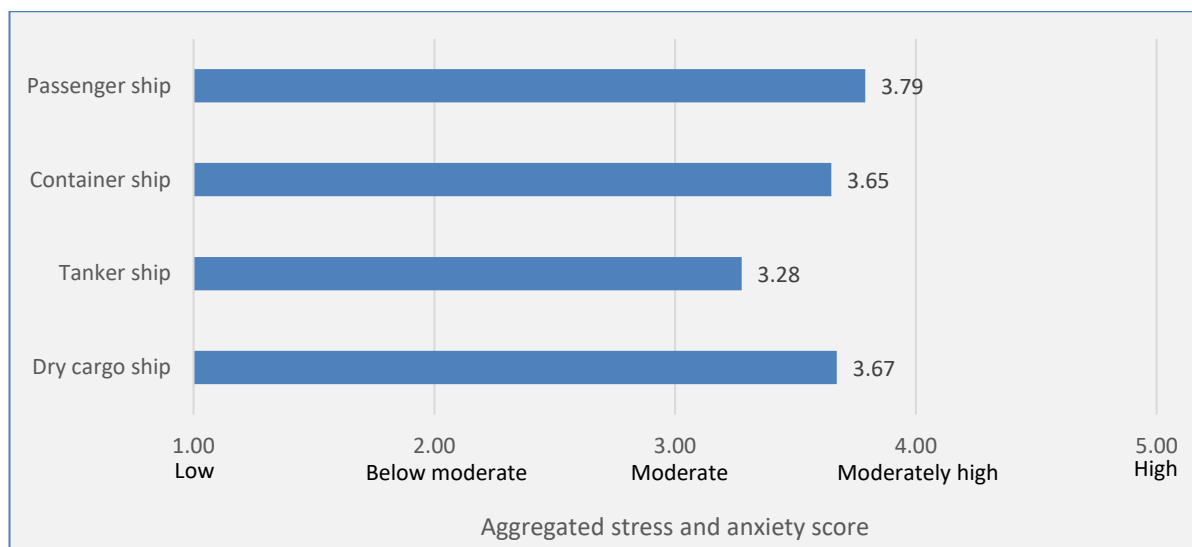
Figure 5: Sources of additional workload during COVID-19 by type of ship



Seafarers’ perceived level of stress and anxiety

Based on the results of the study survey, seafarers on passenger ships reported slightly higher stress/anxiety level compared to seafarers working on other types of ships, at a score of 3.79 on a scale ranging from 1=low to 5=high stress and anxiety. Dry cargo and container ships followed closely with scores of 3.67 and 3.65, respectively. Tanker ships reported the lowest score at 3.28, although still indicating a "moderate" to "moderately high" range of stress and anxiety level. The results reveal that, irrespective of the ship type, the pandemic had a moderately high impact on the mental well-being of seafarers, with passenger ship crews being the most affected (Figure 6).

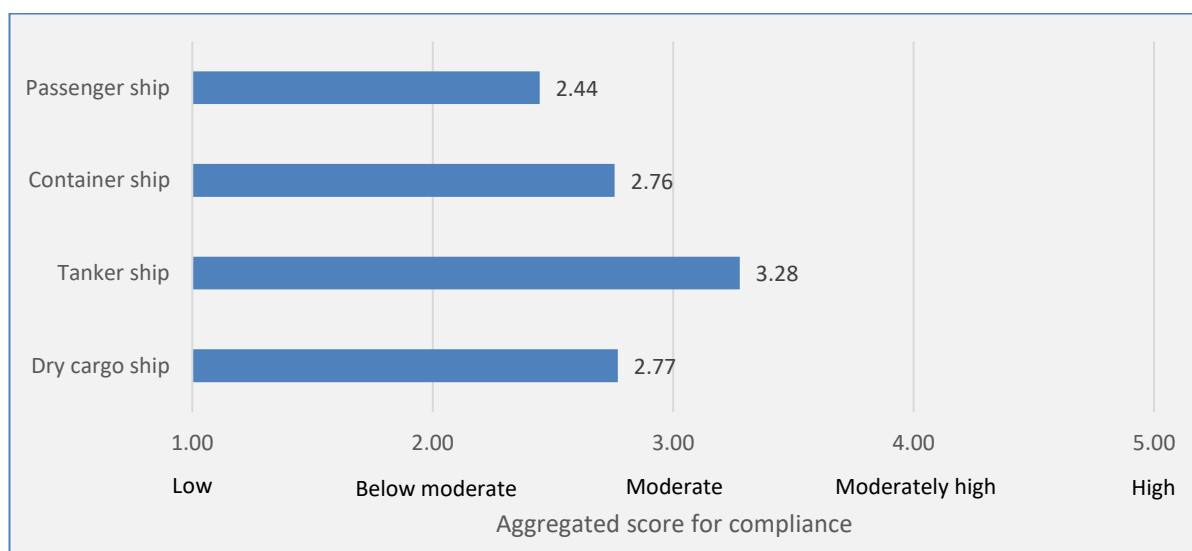
Figure 6: Seafarers’ aggregated stress and anxiety score during COVID-19 by type of ship



Maintenance of seafarers’ hours of rest

From the results of the study survey concerning the compliance with the hours of rest during COVID-19 compared to pre-pandemic conditions, passenger ships had the lowest aggregated score of compliance. Crew members on passenger vessels were largely indicating that their hours of rest were less than moderately respected. Crew on dry cargo and container ships conveyed similar sentiments with marginally better compliance although below moderate levels. Tanker ships were the only ship types which recorded above “moderate” compliance of crew rest hours. These findings highlight that the pandemic influenced work-rest cycles on most ships, with passenger ships experiencing the most pronounced disruptions to regular rest schedules (Figure 7).

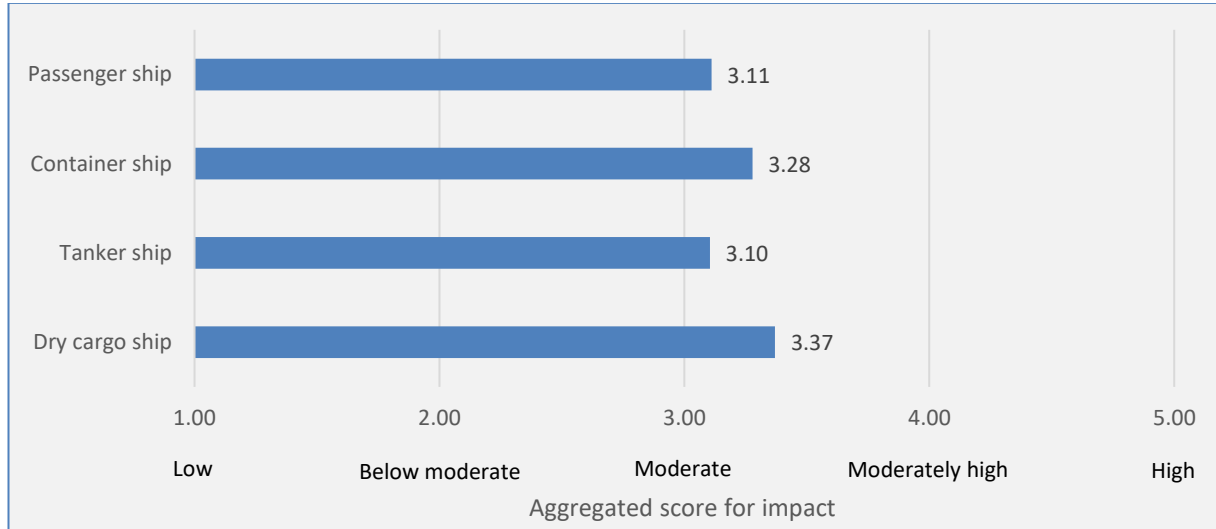
Figure 7: Aggregated score for compliance with hours of rest onboard during COVID-19 by type of ship



The impact of changes in policies, strategies, plans and procedures on safety

In assessing the perceived negative impact of company policy changes due to COVID-19 on onboard safety, the study survey reveals marginally distinct perceptions across ship types and the aggregated score of the impact of these changes on safety in all ship types was determined to be “moderate” to “moderately high”. Tanker and passenger ships, with almost matching scores of 3.10 and 3.11, respectively, suggested a slight inclination towards moderate impact of the policy alterations hampered onboard safety. Nevertheless, it is important to note that no ship type overwhelmingly indicated that these policy alterations severely jeopardized safety (Figure 8).

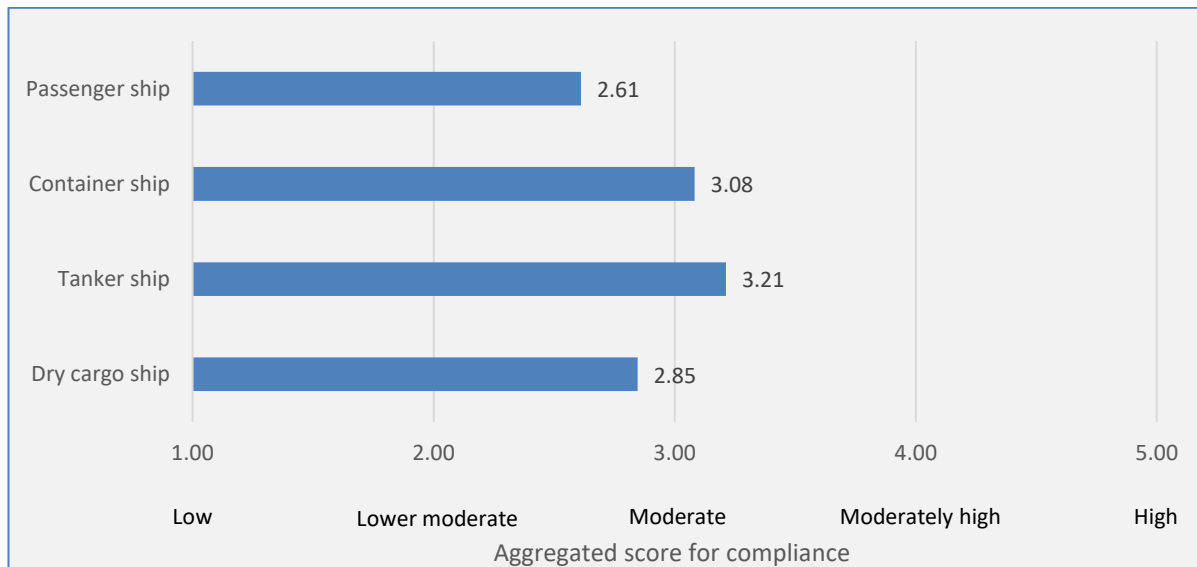
Figure 8: Seafarers’ perception on the impact of changes in policies, strategies, plans and procedures on safety onboard during COVID-19 by type of ship



Compliance with safety and operating standards/procedures onboard

From the data evaluating deviations from established safety and operating standards due to COVID-19, the survey reveals varied perceptions based on ship type. Crew members on passenger ships and dry cargo ships more frequently reported such deviations, with scores of 2.61 and 2.85, respectively, indicating below moderate compliance levels. On the other hand, tanker ships and container ships reported slightly above moderate compliance levels, with scores of 3.21 and 3.08, respectively. These findings imply that during the pandemic, crews on passenger and dry cargo ships experienced a more pronounced deviation from standard safety and operating procedures compared to those on tanker and container ships (Figure 9).

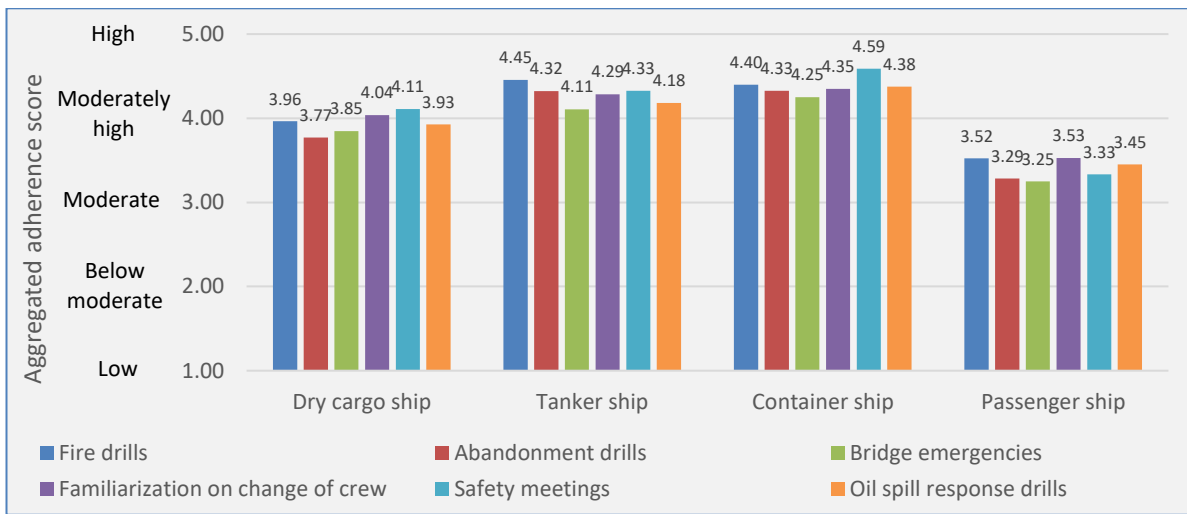
Figure 9: Compliance with the safety and operating standards/procedures onboard during COVID-19



Adherence to scheduled safety training, drills, exercises, and safety meetings requirements

In evaluating compliance with various safety training, drills, exercises, and meetings during COVID-19, the survey results indicate differing levels of adherence across ship types. Tanker and container ships consistently displayed higher compliance with safety training, drills, exercises, and meetings, as evidenced by scores such as 4.45 and 4.40 for fire drills, respectively, and a standout 4.59 for safety meetings on container ships. Passenger ships generally showed moderate adherence, with scores of 3.29 for abandonment drills and 3.25 for bridge emergencies. Dry cargo ships exhibited moderately higher adherence compared to passenger ships in all safety activities. The survey results underscore that tanker and container ships largely maintained safety protocols and activities, while passenger ships experienced notable disruptions during the pandemic (Figure 10).

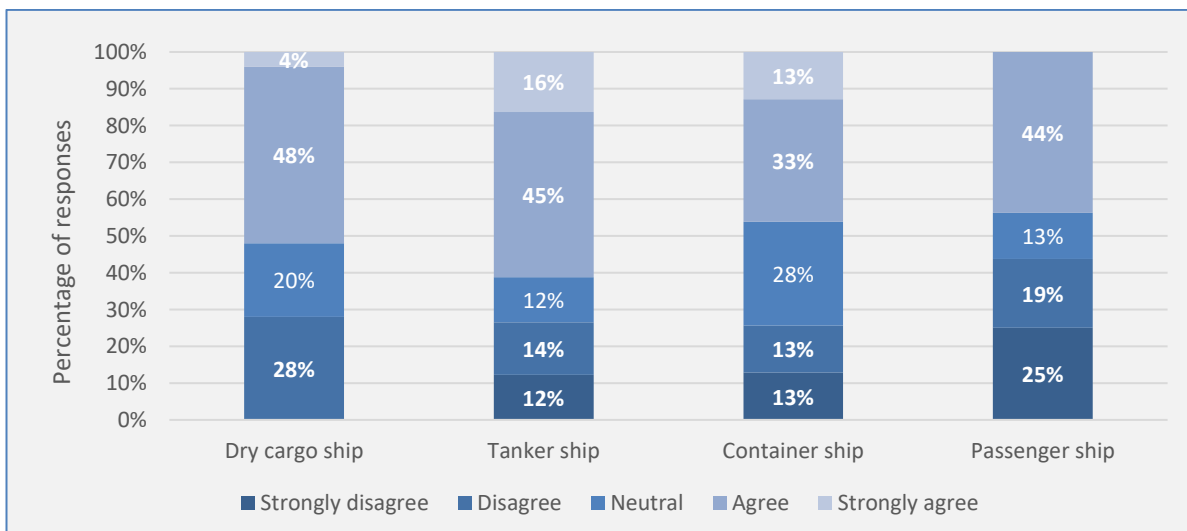
Figure 10: Adherence to safety training, drills, exercises, and safety meetings requirements during COVID-19 by ship type



Effectiveness of remote surveys, inspections and audits compared to physical

During COVID-19, the perception of the effectiveness of remote alternatives to traditional physical surveys, inspections, and audits showed significant variations across ship types. Dry cargo ships appeared more receptive, with 52% of respondents indicating a favourable view (“agree” or “strongly agree”), outweighing the dissenting 28%. Tanker ships reported a similar sentiment, with 61% supporting the efficacy of the remote methods, against 26% who were not in favour. Container ships presented a closer divide at 46% in support compared to the 26% against. However, passenger ships exhibited an equal split with 44% appreciating the remote options and another 44% voicing reservations. Overall, the survey results underscore that while there is a general trend towards accepting remote options in some ship types, passenger ships display a more evenly divided stance (Figure 11).

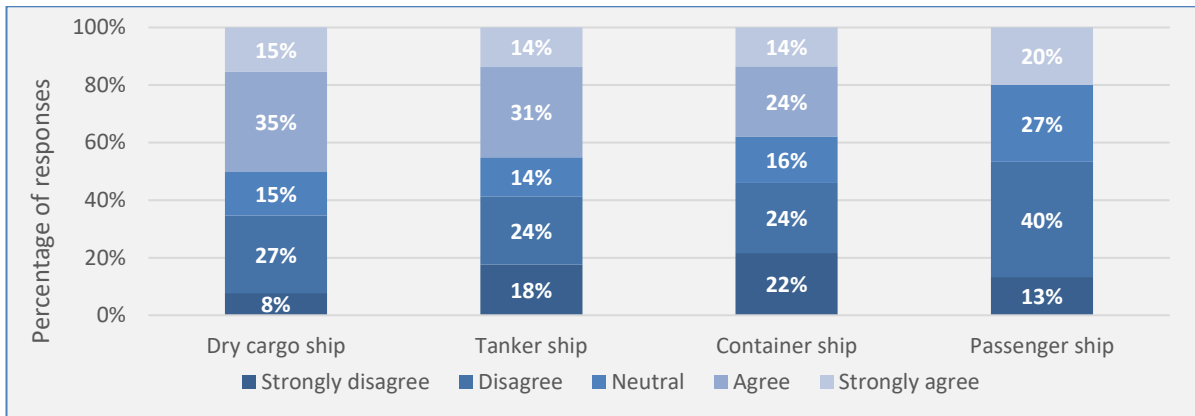
Figure 11: Perceived effectiveness of remote vis-à-vis physical surveys, inspections and audits



Attractiveness of the seafaring profession

Amidst the challenges posed by COVID-19, the attractiveness of the seafaring profession varied across ship types. Dry cargo ships exhibited a mixed response with 35% agreeing and 15% strongly agreeing that the profession remained as attractive, while a combined 35% disagreed or strongly disagreed. Tanker ships showcased a slightly less positive sentiment, with 45% in favour (“agree” or “strongly agree”), and 42% against (“disagree” or “strongly disagree”). Container ships displayed further leaning towards disagreement, with 46% not finding the profession as attractive, compared to the 38% who were in favour. Meanwhile, passenger ships showed the most distinct divide: 20% strongly believed the profession retained its attractiveness, 40% disagreed and another 13% strongly disagreed. Overall, the survey results suggest that while some still find the attractiveness of seafaring unchanged, the pandemic's effects are notably pronounced, especially among passenger ship personnel (Figure 12).

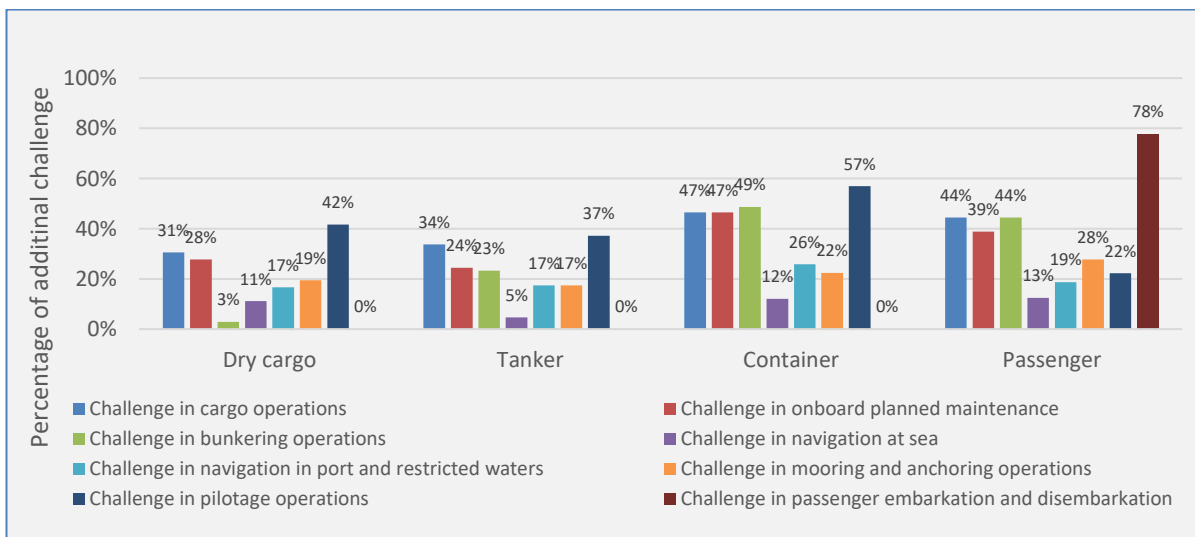
Figure 12: Perceived attractiveness of the seafaring profession by type of ship



Challenges introduced by COVID-19 in undertaking ship operations

Navigating through the COVID-19 pandemic, ships calling European seaports encountered varying degrees of additional operational challenges across ship categories. Passenger ships experienced the most additional strain due to a surge in challenges related to passenger embarkation and disembarkation, with an alarming 78% reporting heightened difficulties. Container ships felt significant additional strain, notably in bunkering operations (49%) and pilotage operations (57%). Cargo operations presented difficulties across all ship types, with container and passenger ships facing the most at 47% and 44%, respectively. While navigation at sea posed relatively minor issues for all types, additional challenges in navigation in port and restricted waters were more pronounced for container ships (26%). The survey results signify that while certain challenges like embarkation and pilotage were ship-specific, others, like cargo operations, were universally exacerbated during the pandemic (Figure 13).

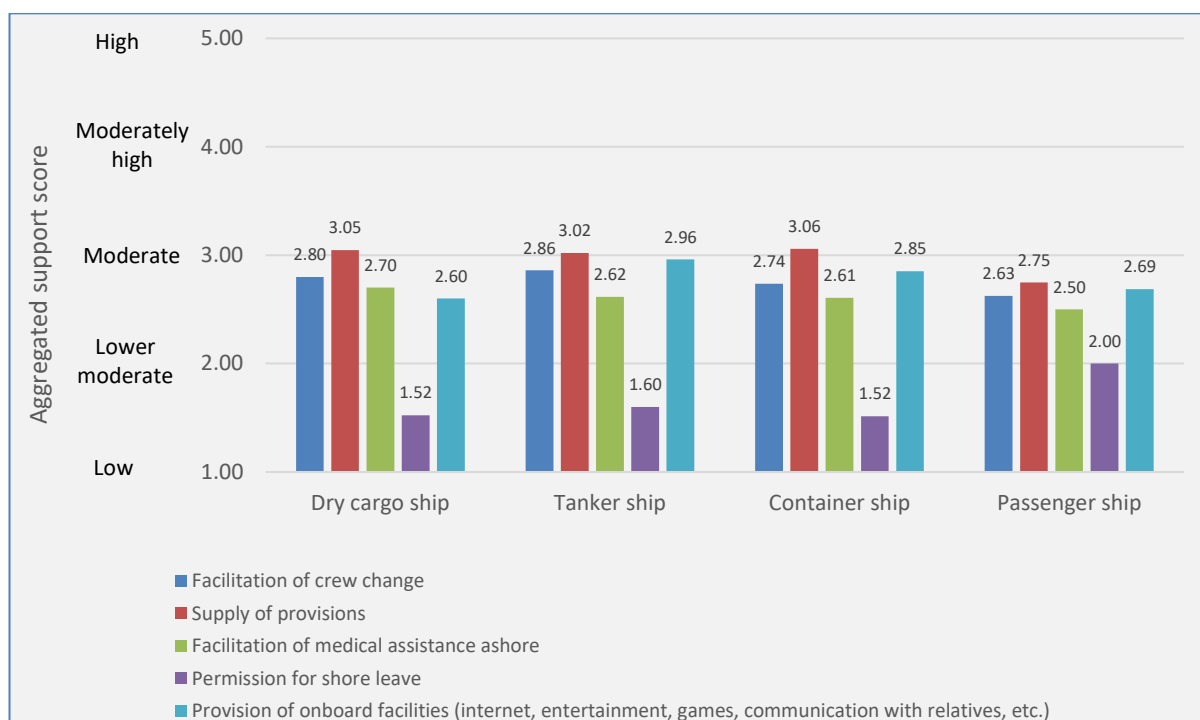
Figure 13: Perceived level of challenges introduced by COVID-19 in undertaking ship operations by type of ship



Perceived level of support received from the shipping company

During the COVID-19 period, seafarers’ satisfaction with support from their shipping companies varied across operational domains. Of all the ship types, the highest satisfaction pertained to the provision of supplies on container ships, scoring a moderate 3.06. On the other hand, company policy (approval) for shore leave was the least satisfactory, with dry cargo, tanker, and container ships all recording scores between “low” and “very low” levels. The facilitation of crew changes and the availability of onboard amenities, such as internet and entertainment, garnered scores close to the “moderate” level. Noteworthy, passenger ships registered a marginally higher score of 2.00 for shore leave permission, still situated within the “low” satisfaction range. Satisfaction with ashore medical assistance remained consistent across ship types, approximating the “moderate” level. These findings indicate that while the provision of supplies was relatively adequate during the pandemic, areas such as shore leave permissions and medical assistance warranted an enhancement (Figure 14).

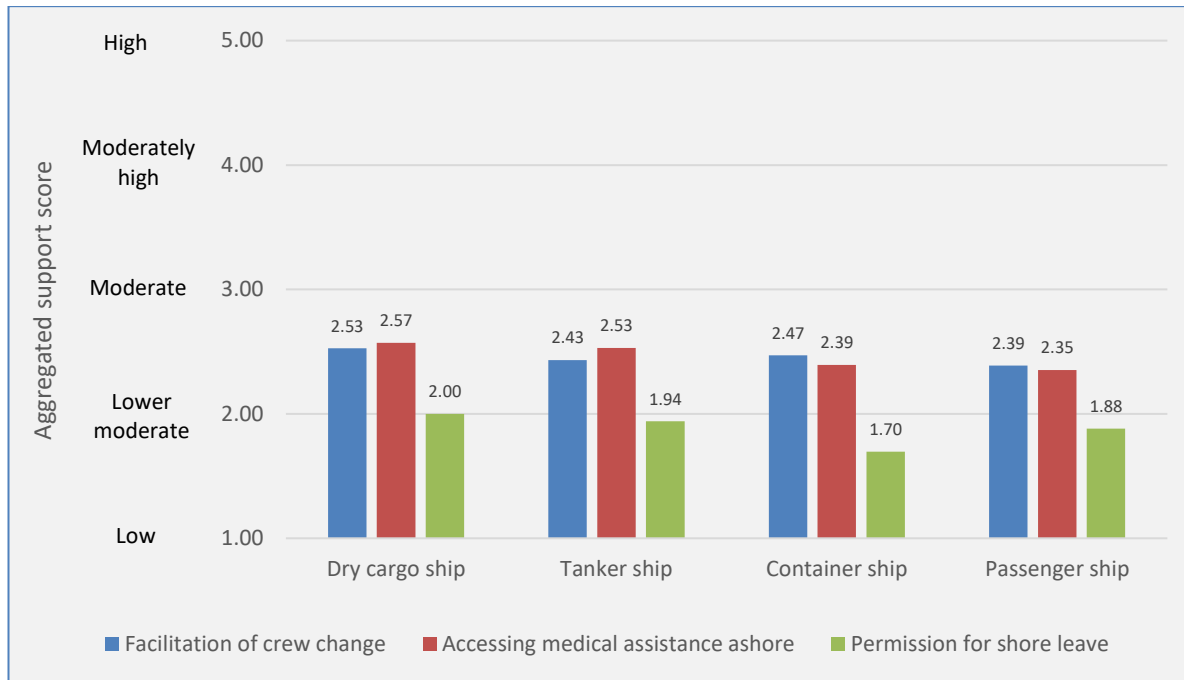
Figure 14: Perceived level of support received from the shipping company



Perceived level of support received at ports

As regards the support received at European seaports during COVID-19, seafarers participating in the survey suggested that the level of assistance was predominantly “fair” to “good”. Facilitation of crew change and access to medical services ashore received “low” to “moderate” scores across all ship types, suggesting that challenges in this domain were uniformly experienced. Permission for shore leave was the area of most concern. Container ships scored the least at a low 1.70, emphasizing a substantial dissatisfaction with permissions at ports for shore leave, while other ships indicated scores between “low” and “very low”. This feedback underscores the need for enhanced measures and policies to better facilitate crew changeovers, medical assistance, and shore leave permissions at European seaports during such crises (Figure 15). As for the non-EU ports, the support offered was widely inconsistent, often influenced by factors such as the flag State of the ship, the nationality of the seafarers, last port of call, and the specific port of call. In particular, several ports in East Asia, Southeast Asia, and South America were often cited for offering very limited support, or no support at all. Concerning health emergencies, several non-EU ports reportedly could not provide the necessary assistance to seafarers, primarily due to stringent COVID-19 protocols in the country, or port, and varied recognition of different vaccine types.

Figure 15: Perceived level of support received at EU ports during COVID-19



Overview

As a synopsis of the results of the survey, Tables 6 and 7 present a composite overview of the wide array of challenges faced by the maritime sector during the COVID-19 pandemic, as highlighted in the key points below.

- The pandemic's impact on onboard workload was clear: crew unavailability due to COVID-19 infections contributed to a 23% increase of workload. The transition to remote audits and surveys contributed to a 22% rise, and the adoption of physical distancing measures resulted in a 20% increase in workload. Over and above all these, shore tasks undertaken by the crew added another 16%.
- Consequently, seafarers' mental well-being was put to the test. On a scale of 5, seafarers reported a moderately high mean stress and anxiety score of 3.59.
- During COVID-19, seafarers' average compliance with onboard rest hours scored 2.80 remaining largely below moderate.
- The collective perception of the negative impact of policy and procedure changes on safety were marginally higher than moderate at 3.21.
- During the pandemic, compliance with safety operating standards/procedures attained a mean score of 2.93 out of 5, leaning towards a moderate rating.
- Nevertheless, an examination of safety-related practices showed positive results. Fire drills, a critical safety measure, achieved a mean score of 4.07, emphasizing moderately high compliance. Abandonment drills and bridge emergencies scored 3.90 and 3.84, respectively. Familiarization during crew changes fetched a mean of 4.04, and safety meetings were close at 4.06.
- Furthermore, when evaluating the effectiveness of remote versus in-person surveys, inspections, and audits, half of the seafarers found the remote methods effective, while 31% expressed reservations.
- Not least, regarding the attractiveness of the seafaring profession, 18% of seafarers expressed a neutral stance. However, a substantial 44% disagreed with the statement: "The seafaring profession remains as attractive for me as it was before COVID-19".

- Operational difficulties were especially evident: cargo operations topped the list with an average disruption of 38%, closely followed by pilotage operations at 37%.
- Regarding the support mechanisms in place, shipping companies provided varying levels of assistance. Crew change facilitation recorded a mean of 2.75. Provisioning, a vital aspect of seafarer well-being, was rated at 2.97. Onboard amenities, crucial for crew morale and communication, averaged 2.77 out of 5.
- As for support from EU Member States' ports, seafarers expressed moderate satisfaction, with crew change facilitation and access to shore medical assistance averaging scores of 2.45 and 2.46, respectively. Permission for shore leave was 1.88.

Table 6: Composite overview of survey results: Percentage scale items

Items		Average	Std. Dev.
Sources of additional workload during COVID-19	Shore tasks performed by the crew	16%	3%
	Unavailability of crew because of Covid-19 infections	23%	5%
	Reduced crew onboard	10%	8%
	Remote audits and surveys	22%	8%
	Physical distancing	20%	2%
	Other	9%	3%
Effectiveness of remote surveys, inspections and audits <i>(Overall effectiveness = Average)</i>	Strongly disagree	13%	6%
	Disagree	18%	7%
	Neutral	18%	8%
	Agree	42%	6%
	Strongly agree	8%	8%
Attractiveness of the seafaring profession <i>(Overall attractiveness= Average)</i>	Strongly disagree	15%	3%
	Disagree	29%	4%
	Neutral	18%	6%
	Agree	23%	6%
	Strongly agree	16%	3%
Additional challenges introduced by COVID-19 <i>(Total additional challenges= 177%)</i>	Challenge in cargo operations	38%	8%
	Challenge in onboard planned maintenance	33%	3%
	Challenge in bunkering operations	20%	5%
	Challenge in navigation at sea	9%	4%
	Challenge in navigation in port and restricted waters	19%	4%
	Challenge in mooring and anchoring operations	21%	4%
	Challenge in pilotage operations	37%	4%

Table 7: Composite overview of survey results: Numerical scale items

Items		Mean	Std. Dev.
Seafarers' stress and anxiety score during COVID-19		3.59	0.22
Maintenance of hours of rest onboard during COVID-19		2.80	0.34
Negative impact of changes in policies, strategies, plans and procedures on safety onboard during COVID-19		3.21	0.13
Compliance with safety standards and procedures onboard during COVID-19		2.93	0.27
Adherence to scheduled safety training, drills, exercises, and safety meetings requirements during COVID-19 by ship type (Overall mean 3.99)	Fire drills	4.07	1.13
	Abandonment drills	3.90	1.06
	Bridge emergencies	3.84	0.96
	Familiarization on change of crew	4.04	1.00
	Safety meetings	4.06	1.18
	Oil spill response drills	3.97	1.05
Support received from shipping company during COVID-19 (Overall mean 2.55)	Facilitation of crew change	2.75	0.31
	Supply of provisions	2.97	0.43
	Facilitation of medical assistance ashore	2.60	0.28
	Permission for shore leave	1.65	0.24
	Provision of onboard facilities (internet, games, entertainment, communication with relatives, etc.)	2.77	0.27
Support received at EU ports during COVID-19 (Overall mean 2.26)	Facilitation of crew change	2.45	0.54
	Accessing medical assistance ashore	2.46	0.43
	Permission for shore leave	1.88	0.35

2.3.3 Results of focus group discussion

In a workshop facilitated by the World Maritime University, 15 selected participants discussed the impacts of COVID-19 on the maritime industry within the scope of the study. Among the participants, five were seafarers with experience on different types of ships, ranging from master mariners to chief engineers, each bringing a wealth of experience from their time at sea and in maritime training roles with more than 15 years. The remaining ten were company representatives from prominent shipping companies, including fleet superintendents, fleet managers, operations directors, company security officers, Designated Person Ashore, health and safety executive, naval architects, and a maritime instructor from shipping company's training department. Their collective expertise provided a comprehensive perspective on the challenges and solutions in the maritime industry during the global health crisis.

The workshop has been organized in three pivotal sessions. Session 1 discussed "Changes in Normal Operations and Stakeholder Response," detailing the operational shifts during the pandemic and while Session 2 focused on "Emerging Risks and Potential Safety Issues," the final Session 3 encapsulated "Lessons Learned and Mitigation Measures," aiming to consolidate strategies to address the presented challenges.

The perspectives of seafarers and shipping companies of COVID-19 emanating from the results of the focus group discussion are presented below.

2.3.3.1 Seafarers' perspectives of COVID-19

Seafarers during the workshop revealed several challenges, implications, and strategies associated with their experiences during the pandemic. The perspectives of seafarers are thematically segmented into four main areas, as presented below.

- Seafarers' challenges and well-being:** Throughout the workshop, it was abundantly clear that seafarers have faced substantial challenges during the pandemic, many of which have been detrimental to their well-being. The difficulties surrounding crew changes during the pandemic were highlighted, with many getting "*stuck at*

sea or on the ships without proper rotations.” This logistical challenge not only impacted operations but also imposed significant mental and emotional strains on seafarers, magnifying their feelings of isolation and uncertainty. As a Master stated, *“mental health was a massive issue during this time... for many of my crew, the isolation was already tough. But knowing they couldn't go home and worrying about their families, it was a heavy burden to bear.”* Another master added, *“it was not just the physical strain but also the emotional and psychological strain.”*

The social distancing added another layer of challenges especially during interaction with shore-based personnel, as a Master recalling his experience said, *“...during pilotage operations I was on one wing and the pilot was on the other wing ..., some pilots refused to wear mask, what should I do as master to protect my crew?”*

While technological advancements like virtual meetings, online trainings and remote inspections provide some solutions, they also brought a new set of challenges for seafarers. For instance, the transition from face-to-face meetings to virtual platforms has seen some hurdles, as indicated by a Master's remark, *“technological issues during virtual meetings can lead to misunderstandings or missing out on critical discussions.”*

The workshop discussions also touched upon the cultural diversity of crews onboard. In this regard a Master highlighted that *“mixing cultures hasn't been a significant issue for us.”* This observation demonstrates the broader acceptance and mutual respect among the seafaring community of varied cultures.

- **Medical preparedness on ships:** The focus group discussions emphasized the urgent need for enhanced medical preparedness on ships. A Master stated, *“I believe that our medical standard for officers and the master should be increased... They should be well equipped to handle situations like serious fractures, bleeding, or someone fainting.”* This need goes beyond addressing immediate emergencies, such as physical injuries and fractures, to include potential mental health crises, as another Master stated, *“we need more practical training during the STCW refreshment courses. It shouldn't be restricted to just care such as injections and fractures, but also for mental health care.”*

Another point of discussion was the use of AI for monitoring seafarer behaviour in the context of mental health. In the maritime realm⁴¹, innovative solutions like Scoutbase⁴² and BlueSkeye⁴³ AI have been introduced as a call for action, but not yet implemented. Scoutbase works on well-being, analysing up to 400 data points per vessel monthly, BlueSkeye AI employs Ethical AI, utilizing face and voice sensing to detect potential well-being issues. Sensing Feeling leverages CCTV cameras to analyse behavioural patterns during high-risk tasks. Care4C⁴⁴ focuses on fatigue, tracking sleep patterns via wristband sensors, while Litha Group employs a chatbot for emotional expression and, Senseye's technology examines the iris for signs of fatigue or stress. Although AI tools may facilitate mental health, medical supervision and balancing use of AI with human interaction remains crucial. While many participants recognized the benefits of AI in overseeing shipboard behaviours for safety, some crew expressed concerns and were reluctant about the idea of being subject to constant surveillance, comparing it to a *“Big Brother”* situation.

- **Rights and recognition:** The focus group discussions highlighted the pivotal role that seafarers play in the global trade framework. Their unmatched contributions, especially during challenging times, amplify the importance of recognizing them as essential workers and ensuring their rights and well-being are prioritized. As a Master stated, *“Seafarers play a pivotal role in society, especially during crises. Their contributions should be recognized and valued by the society.”* A fishing industry representative joined saying, *“absolutely, all seafarers should be recognized, including those from fishing industry.”* As agreed by the workshop participants, resolving the issue of recognition would have tangible effects on crew changes and seafarer mobility, especially in countries where they are not deemed essential workers. Furthermore, this acknowledgement was not just limited to those in conventional maritime roles. There was a collective agreement on the need to recognize everyone within the sector, including individuals in the fishing industry.
- **Operational challenges:** During the focus group discussion, a few prominent trends in maritime operations emerged in the wake of recent challenges. Firstly, the pandemic underscored the necessity for swift adaptability in operations. A Master proposed a concept of a dual management system, *“It is an interesting concept if we were to have a dual management system, one for business as usual and another for exceptional*

⁴¹ Lloyds Register. (2023). Technology for seafarer mental welfare. <https://www.lr.org/en/knowledge/industry-news/2021/technology-for-seafarer-mental-welfare/>

⁴² <https://scoutbase.com/>

⁴³ <https://www.blueskeye.com/>

⁴⁴ <https://www.care4c.com/>

circumstances.” This approach emphasized the industry's resilience and the importance of preparedness. A notable operational shift discussed was the move from in-person meetings to virtual formats. While acknowledging the cost-effectiveness of the change, workshop participants also voiced concerns about potential compromise in the quality of communication besides technological challenges including network disruptions, hardware and software issues (frozen, bugs, cuts, etc.).

- **Other concerns:** From the focus group discussions, several overarching concerns emerged that transcend specific maritime sectors. A dominant theme was the call for more cohesive efforts in crisis response. As a Master expressed, “... *there is a need for global, or at the very least regional, harmonization, particularly when addressing challenges like seafarer travel during pandemics or formulating consistent safety protocols.*” Drawing from the past also resonated among the participants, who emphasized the importance of leveraging historical data from previous outbreaks and crises to craft efficient strategies. This perspective aligned with a broader theme: the significance of preparedness. In this context, the necessity to investigate and implement the lessons learned for future generations was also highlighted in order to be able to cope with similar crisis situations that may occur in the future.

In conclusion, the workshop sessions, through the eyes of seafarers, revealed key maritime concerns, emphasizing their vital role and well-being. The insights obtained are crucial for shaping policies, operational adaptations, and promoting a stronger maritime industry.

2.3.3.2 Shipping companies' perspectives of COVID-19

Following insights shared by seafarers during the workshop – highlighting the challenges, implications, and strategies related to their pandemic experiences – this subsection shifts focus to the perspective of shipping companies. The perspectives of shipping companies are thematically segmented into five distinct areas, as presented below.

- **Policy and governance:** During the discussions, it was highlighted that there were increased collaborations between maritime stakeholders at the national, regional and global level. A Fleet Manager stated, “...*we also saw an increased level of collaboration across the industry. Companies shared best practices, solutions, and resources. This level of cooperation was a silver lining during the tough times.*” On the other hand, a pressing need for harmonised policies for seafarers came to the fore during discussions. Inconsistencies across jurisdictions create obstacles, not only for seafarers' rights but also for shipping companies grappling with compliances of diverse regimes and potential legal pitfalls, as agreed by all the workshop participants. This led to a unanimous call for enhanced global collaboration, emphasizing the pivotal role of international partnerships, both public and private, in ensuring the maritime sector's resilience and continued growth through harmonized regulations. A HR manager provided an example in this context: “... *the airline industry has set standards, and this pandemic exposed the discrepancies in the treatment of seafarers. While recognizing that security is essential, we need a globally harmonized approach to ensure that seafarers can operate efficiently, especially during crises.*” A disconnect was also revealed between formal regulations and the ground realities confronted by seafarers and companies. There was also a distinct concern among shipping company representatives regarding data collection, particularly around sensitive incidents, such as suicide, and depression cases. The discussions underlined the necessity for a transparent yet secure and anonymous platform for incident reporting, aiming to maintain accountability while safeguarding critical information.
- **Economic and contractual concerns:** During the discussions, shipping companies highlighted a spectrum of economic and contractual challenges emerging from the pandemic's fallout. As exemplified by an HR manager, “...*there were cases of crew members being quarantined in hotels, resulting in significant additional costs of crew change, nearly five times more than usual...*” Changes in financial dynamics manifested through disrupted trade routes, supply chain interruptions, and revenue reductions. This compelled companies to adapt swiftly, often incurring additional, unexpected costs. A specific operational adaptation was the inception of “*back-to-back*” crew contracts. As stated by an HR manager, “...*having fixed positions might be beneficial. It ensures consistency and familiarity, reducing the need for constant retraining. However, it might restrict flexibility for the crew.*” Additionally, as highlighted by seafarers, the necessity of emergency health preparedness was also recognized by the shipping company staff, however it raised financial concerns as companies sought to strike a balance between profitability and safety investments.
- **Technological shifts:** In light of the global COVID-19 pandemic, various industries, including shipping, experienced a rapid acceleration towards digital solutions. The restrictions imposed during the pandemic prompted sectors to embrace technology-centred solutions, faster than ever before, if only to maintain business continuity. In the realm of technological shifts, shipping companies acknowledged the enormous potential of AI

to enhance ship operations. Shipping companies are working together with IT companies, using AI-powered platforms to optimize ships' routes and schedules, tracking cargo, reducing the risk of cargo loss, and increasing the efficiency of shipping operations⁴⁵ among other uses. Further signalling the technological shift, EMSA⁴⁶, in collaboration with IT experts, has launched an AI-supported pilot service in European waters. The tool utilizes Natural Language Processing (NLP) algorithms to standardize AIS-reported 'destinations' into United Nations Economic Commission for Europe (UNECE) codes, enhancing reporting accuracy and improving vessel position predictability.

At the same time, concerns were also expressed about data privacy and an over-reliance on AI technology. As a DPA opined, *“Technological advancements, such as AI, are increasing onboard ships. This changes the dynamics and may introduce new risks such as cyber risks.”* However, opinion on whether the rise in digitalization is likely to escalate cybersecurity risks remained divided among the workshop participants. Regardless, digitalisation makes safeguarding sensitive data and ensuring continued operations against cyber threats paramount. Another issue discussed in this context was data integrity and longevity. As the industry pivots toward digital data storage, worries about data integrity and longevity arise, emphasizing the need for sustainable storage solutions.

- **Operational resilience and planning:** When discussing operational resilience and planning, representatives from shipping companies highlighted the vital importance of proactive contingency planning. They also stressed the need to incorporate lessons learned into new company strategies. One DPA remarked, *“While we hope not to face another pandemic soon, it's imperative that we retain these lessons and integrate them into our contingency plans.”* This sentiment was echoed by a participant from the fishing industry, *“This principle applies not only to the maritime industry but to every sector. All organizations should have contingency plans in place, ready for activation when necessary. It's a lesson for all.”*

A maritime expert pointed out that companies equipped with solid strategies and contingency plans were better poised to navigate the challenges posed by the pandemic compared to those that were less prepared. The importance of drawing insights from past crises was emphasized, as historical understanding can guide more effective responses in the future.

In terms of ensuring the resilience and continuity of maritime operations, while virtual platforms proved invaluable during lockdowns, they can't replace the depth of in-person interactions. Such face-to-face communications are particularly crucial in crisis situations. Moreover, the pandemic underscored the significance of maintaining flexible and diversified supply chains. Companies that either had multiple suppliers or were agile enough to swiftly adjust their operations showcased enhanced resilience during these unprecedented times.

- **Health and safety protocols:** In line with the seafarers' perspective, shipping companies have emphasized a holistic approach to seafarers' health. The approach prioritizes not only physical health but also mental well-being. A HR manager stated, *“Medical examinations of seafarers focus on physical health, but not mental ... medical checks are required every two years. This process may soon include mental health checks.”* Shipping companies recognize the essentiality of comprehensive health protocols for the complete well-being of their crew. For consistent health and safety standards, collaborations with external agencies, especially health organizations, are deemed vital by participants. This mirrors the seafarers' views, emphasizing the significant role of onboard medical teams. Expanding their training, particularly in mental health, has emerged as a central concern. Furthermore, these collaborative efforts between various stakeholders can forge robust solutions. Participants also spotlighted the intertwined nature of mental health, well-being, and human factors. This interrelation became especially pronounced in discussions about human factors in marine casualties and incidents. An HR manager revealed, *“After COVID-19, there has been a more pronounced focus on human factors in casualty investigation reports compared to pre-COVID times.”* By sharing best practices, challenges, and innovations, the maritime sector can undergo a transformation, fostering safer and more efficient operations.

In conclusion, from the perspective of shipping companies, there was an acknowledgement and clear understanding that the maritime industry stands at the crossroads of change. Navigating these challenges requires

⁴⁵ Wong, S., Yeung, J. K. W., Lau, Y. Y., & Kawasaki, T. (2023). A Case Study of How Maersk Adopts Cloud-Based Blockchain Integrated with Machine Learning for Sustainable Practices. *Sustainability*, 15(9), 7305.

⁴⁶ EMSA. (2023). Another step in the development of AI applications in IMS. <https://emsa.europa.eu/newsroom/latest-news/item/5044-another-step-in-the-development-of-ai-applications-in-ims.html>

collaborative, adaptive, and forward-thinking approaches. Ensuring the well-being of seafarers, integrating technology effectively, and maintaining operational resilience are foundational to the industry's future success.

Besides the workshop discussions, participants also engaged in validating the study's findings, particularly those concerning post-COVID-19 emerging risks and potential safety issues in the maritime sector. The experts in attendance were invited to participate in a dedicated survey, which was built upon the study's preliminary results. The survey allowed these industry professionals to evaluate the significance of the identified risks and safety issues in this study. The collective feedback from participants not only strengthened the validity of the findings but also provided detailed insights. The complete results of this validation are presented in Section 2.4 of the report.

Table 8: Overview of the thematic perspectives of focus group discussions on COVID-19

Participant category	Thematic perspectives of COVID-19
Seafarers	Seafarers' challenges and well-being
	Medical preparedness on ships
	Rights and recognition
	Operational challenges
	Other concerns
Shipping companies	Policy and governance
	Economic and contractual concerns
	Technological shifts
	Operational resilience and planning
	Health and safety protocols

2.4 Emerging risks and potential safety issues: analysis of the study results

The maritime industry underwent dramatic shifts in operational dynamics as the COVID-19 pandemic unfolded. Deviations from the “normal operations” presented challenges to crew members and shipping companies across different ship types, notably passenger, container, general cargo, and tanker ships. This section seeks to elucidate the potential safety issues and emerging risks stemming from the operational disruptions.

2.4.1 Changes to normal operations due to COVID-19

The maritime industry has undergone significant changes due to the COVID-19 pandemic and challenges imposed by it. The study examined the changes brought on by the COVID-19 pandemic with reference to the pre-pandemic baseline.

In particular, three time periods are considered for the purposes of this study in respect of global actions taken against the pandemic:

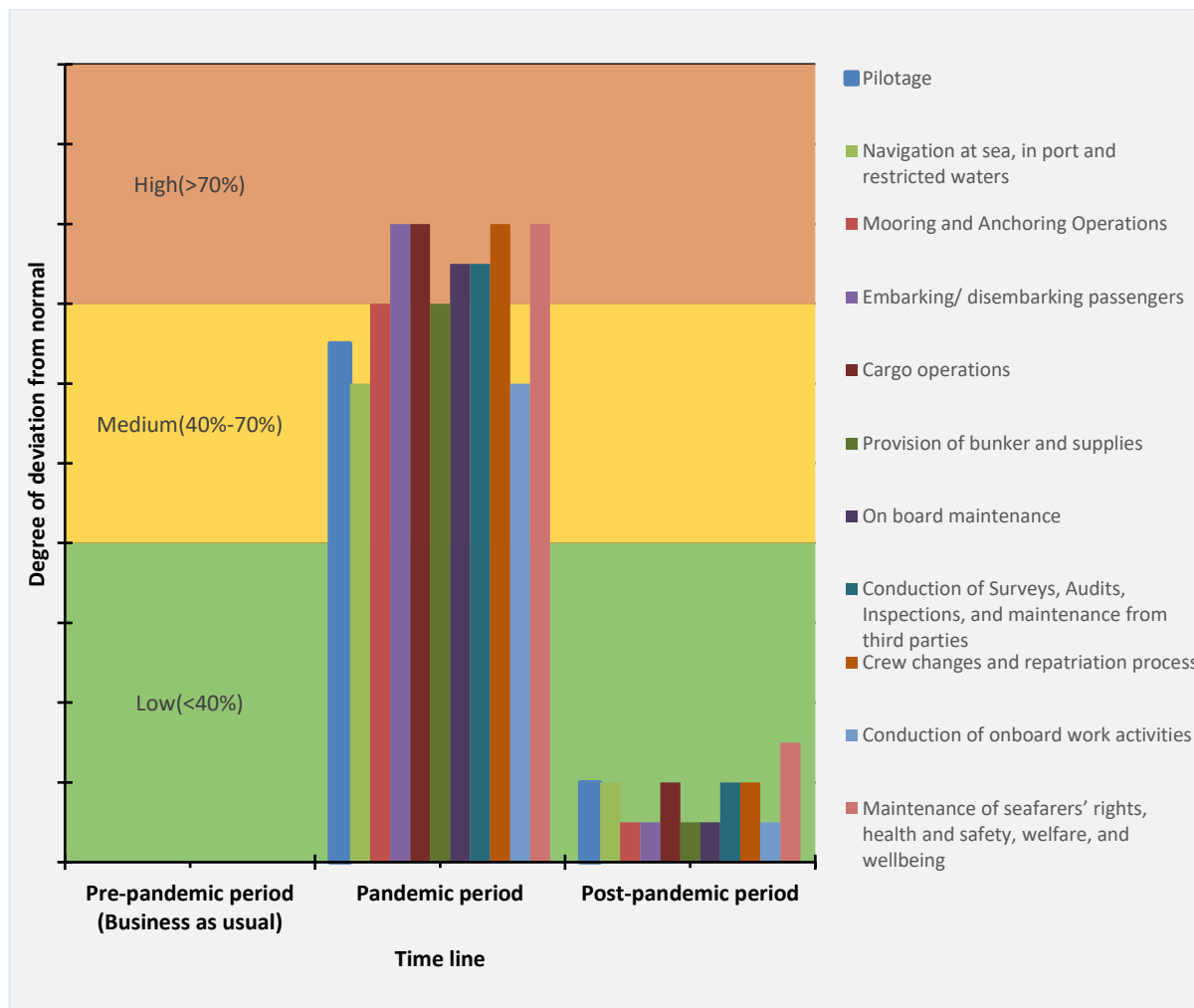
- the “pre-pandemic” period from January 1, 2019, to March 11, 2020, corresponding to the official pandemic declaration from WHO in which, there were uncertainties, lacking in global regulatory standards as well as a road map to deal with pandemic and therefore the industry faced big challenges and required to adapt;
- the “pandemic period” referring to the period from March 12, 2020, to May 5, 2023, in which, all stakeholders of maritime industry put many efforts and new norms, standards, practices were adopted; and
- the “current period” referring to the period from May 6, 2023, onwards, in which the maritime industry is in a new phase dealing with the lessons learned and trying to seek a balance in the changed situation.

The overall changes to the normal are presented below as per the operations in the realm of the ship and the operations in the realm of the company. The perceived changes are obtained from the interview and questionnaire outcomes utilizing a Likert linguistic scale of 3 ranging from Low (<40%) to Medium (40%-70%) and High (>70%). The results have been validated through the focus group discussion during the workshop. The cumulative change in each operation is projected by calculating the average of the specific changes under each operation (see Annex for further details).

2.4.1.1 Changes to normal operations in the realm of the ship

Changes to normal operations in the realm of the ship are presented in Figure 16 by the different periods of pandemic. A discussion on the individual operations follows.

Figure 16: Changes to normal operations in the realm of the ship by pandemic period



S1-Pilotage

In the pandemic period, deviations in pilotage operations reached a moderately high level, particularly due to physical distancing measures and constraints in boarding ships. However, the overall impact on pilotage operations was deemed manageable. A wide range of adaptations emerged during the pandemic, ranging from pilots boarding vessels in full hazmat suits to conducting pilotage remotely without any direct unsafe occurrence (e.g., accidents, incidents, or near misses). Nonetheless, it was underscored that these measures escalated the workload, with particular emphasis on the adverse psychological impact, such as increased anxiety and stress, on the bridge team and maritime pilots due to the COVID experience. Consequently, these challenges influenced the career trajectory of several maritime pilots, prompting premature retirements and career transitions. Therefore, a critical concern has been raised: the potential difficulty in sourcing seasoned maritime pilots and ensuring knowledge transfer to the next generation of pilots in the short to mid-term future, spanning 3-5 years.

S2-Navigation at sea, in port and restricted waters

Reduced information exchange within the bridge team during COVID-19 emerged as a significant concern, hampering the essential flow of data required for accurate decision-making and secure navigation. The combination of remote supervision and diminished crew numbers due to COVID infections undermined operational oversight and overall efficiency. The compounded effects of an increased workload and heightened stress, alongside reduced staff numbers, impacted the focus on navigation. These challenges, along with changes in

communication patterns and oversight, led to extended times for emergency response, underscoring the urgency for decisive action. Navigation saw heightened deviations during the pandemic, reflecting obstacles particularly when dealing with infected crew members and interrupted pilotage processes. However, post-pandemic, operations resumed their usual course, with such deviations returning to levels observed before the pandemic.

S3-Mooring and anchoring operations

During the pandemic, mooring and anchoring operations experienced a significant uptick in deviations, primarily attributed to decreased interactions among mooring parties, especially between the crew, pilots, and onshore mooring staff, exacerbated by distancing measures and mask-wearing. While no direct accidents were identified as a consequence of these factors, the diminished interactions and additional workload contributed to prolonged response times during incidents, such as ship line jams or tug line breakages. Additionally, concerns were raised about the potential short to mid-term challenges the industry might face due to a shortage of senior and experienced maritime professionals both onboard and ashore.

S4-Embarking/disembarking passengers

During the pandemic period, the passenger shipping industry underwent profound changes, most notably the complete suspension of operations and the fleet's lay-up in some cases. Due to significantly reduced demand for passenger shipping, companies pivoted to a more cargo-centric approach to maintain fleet operations. Amidst the pandemic, operations related to passenger embarkation and disembarkation saw marked deviations, largely due to diminished external assistance for cases such as cleaning, temperature checks, and enhanced hygiene measures, which in turn intensified the crew's workload. Additionally, the time required for these operations grew considerably, as tasks related to passenger communication and supervision expanded. However, post-pandemic, these deviations substantially decreased, with operations reverting to their pre-COVID norms.

S5-Cargo operations

Cargo operations encountered moderate disruption during the pandemic, which have since improved. Reduced support from shore-based cargo personnel disrupted operations, leading to delays and challenges, thereby increasing crew workload during the COVID-19 period. A decrease in crew members due to infections compromised task efficiency and placed additional burdens on the remaining team members. Limited interactions between cargo parties hindered coordination and reduced the efficiency of supervision. As a result, issues related to cargo lashing and misplacement of cargo loads were reported during the COVID-19 period. Changes in work dynamics, encompassing remote and expedited supervision, affected the smooth execution of oversight and adherence to safety protocols. Extended cargo operation times, due to additional tests and checks, impacted overall efficiency and turnaround. In the post-pandemic period, a decline in supervision and oversight efficiency is observed, indicating the need for close monitoring.

S6-Provision of bunker and supplies

The provision of bunker and supplies faced moderate disruption during the pandemic. A diminished availability of bunker and equipment suppliers created operational challenges. Due to fewer equipment suppliers, routine maintenance transitioned from planned practices to condition-based approaches. Travel restrictions and decreased personnel availability disrupted logistics, leading to inconsistent supply deliveries. A reduced workforce in bunkering and supply operations hampered efficient quality monitoring and communication with suppliers. Although operations have not completely returned to normalcy, mainly due to the closure of some suppliers, no prolonged significant changes in the provision of bunker and supplies have been observed.

S7-Onboard maintenance

Amid the pandemic, onboard maintenance operations faced deviations from standard practices due to factors such as limited spare part supplies, decreased crew numbers (attributed to infections), and diminished support from shore-based technical personnel. The primary deviations included irregular supplies resulting from disruptions in the logistics chain and the unavailability of spare parts. To optimize the use of available spares, a shift towards condition-based maintenance was implemented. Post-pandemic, these deviations have substantially decreased, and operations have largely returned to business as usual. However, challenges persist due to reduced market availability of certain spares, stemming from the closure of key suppliers and the drydocking of ships for maintenance.

S8-Conduct of surveys, audits, inspections, and maintenance from third parties

During the pandemic, significant deviations were observed in conducting surveys, audits, inspections, and maintenance by third parties. The introduction of dynamic health protocols in response to COVID-19 hindered the ability of third-party personnel, including inspectors, auditors, surveyors, and maintenance staff, to travel and board ships. This led to challenges and delays in regular compliance checks, prompting the industry to adopt remote practices and extend certification durations. With a reduced pool of exclusive inspectors due to infections, quarantines, and a notable lack of senior professionals, the industry had to rely on non-exclusive local surveyors, and supported virtually as required, to maintain inspection regime. The shortage of senior and experienced inspectors is perceived as a challenge that may impact the industry in both the short and mid-term (3-5 years).

S9-Crew changes and repatriation process

Crew changes and repatriation are among the operations that experienced the most substantial deviations during the pandemic. The primary drivers of this change included an inconsistent global response, fluctuating COVID-19 cases, evolving measures, stringent health protocols, travel limitations, and escalating costs. Crew members grappled with heightened workloads and stress, while uncertainties surrounding repatriation and prolonged onboard stays (reaching up to 15 months) took a toll on their well-being. Although these deviations have diminished in the current period, the pandemic's impact on seafarers has raised concerns. The negative effects on their occupational continuity and overall outlook towards a seafaring career might necessitate proactive measures to prevent potential shortages in the future.

S10-Conduct of onboard work activities

During the COVID-19 pandemic, a significant challenge arose from the decreased availability of crew members due to infections and quarantines. This presented difficulties for onboard tasks like maintenance and drills, which rely on team collaboration. The use of personal protective equipment (PPE), rigorous health screenings, and social distancing measures resulted in increased workloads and stress, negatively affecting crew performance. Restrictions on physical access to training facilities and certification processes pushed the industry towards remote solutions, which in turn affected the practical skillsets of seafarers. This, combined with a reduced crew count, modified communication methods, and remote supervision, extended emergency response times. Although operations have largely returned to normal post-pandemic, concerns persist about the increased workload, stress, and potential short- to mid-term impacts on supervision efficiency and oversight.

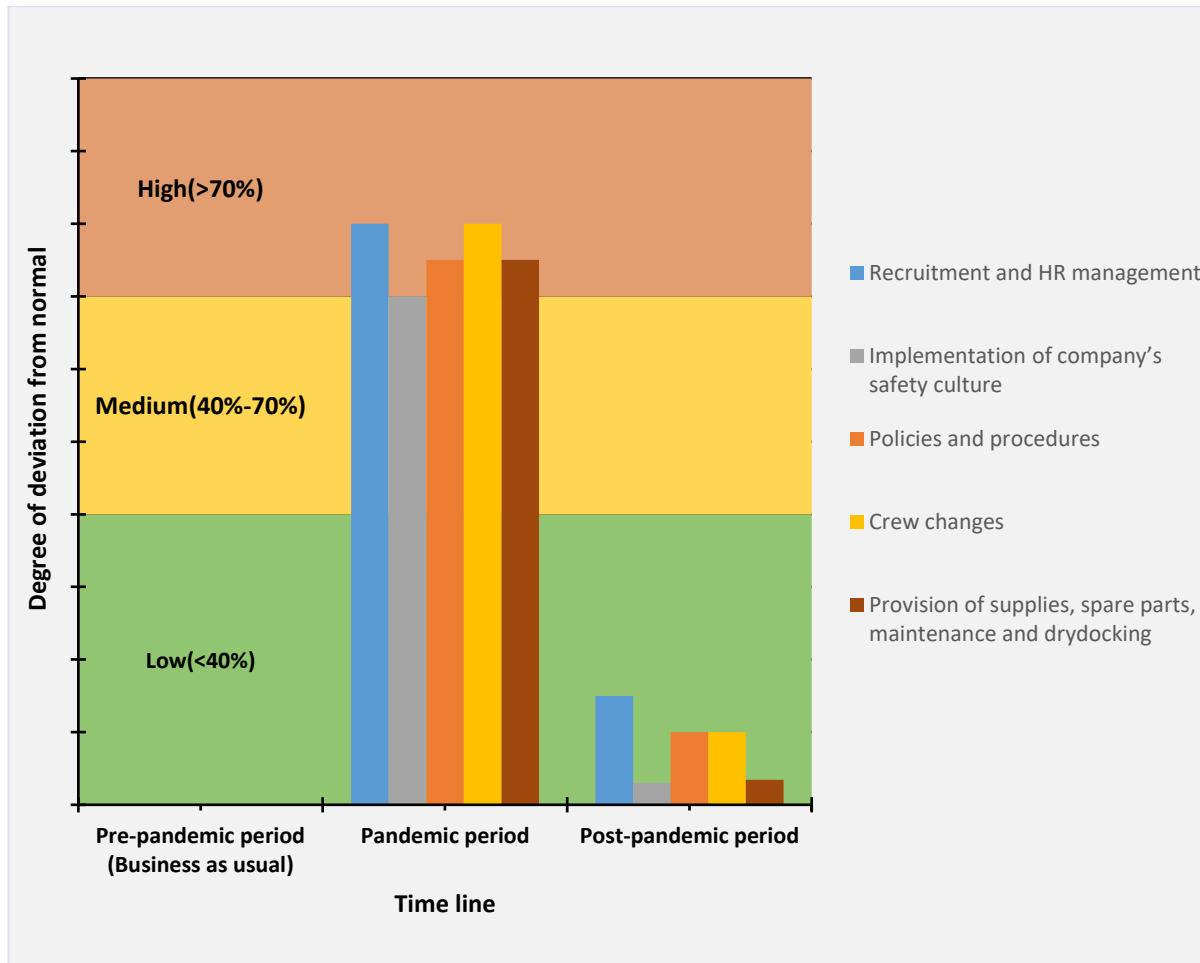
S11-Maintenance of seafarers' rights, health and safety, welfare, and wellbeing

During the COVID-19 period, the maintenance of seafarers' rights underwent significant deviations from standard operations, primarily due to the suspension of shore leaves, crew changes, and limited on-board crew amenities. While some shipping companies proactively improved crew amenities, including enhanced internet access and fitness facilities, the quality of provisions varied widely across vessels. This inconsistency affected crew morale, mental health, and well-being, especially during voyages and extended, socially isolated port stays paired with lengthier contracts. The pandemic's stringent policies on shore leaves curtailed seafarers' freedom of movement, reshaping their perspectives on maritime careers and future aspirations. Additionally, access to onshore medical assistance shifted, prioritizing critical cases. This left seafarer managing non-critical health issues with telemedical assistance and limited on-board facilities. The upkeep of seafarers' rights, health, safety, welfare, and overall well-being is underscored as the primary concern for the mid- and long-term, crucial for retaining skilled seafarers and ensuring their continued contribution to the industry.

2.4.1.2 Changes to normal operations in the realm of the company

An overview of changes to normal operations in the realm of the company is presented in Figure 17. A brief discussion on the individual operations ensues.

Figure 17: Changes to normal operations in the realm of the company by pandemic period



C1-Recruitment and HR management

During the COVID-19 period, recruitment and HR management within the maritime sector underwent significant shifts from standard practices. The ever-changing health protocols, influenced by the ongoing pandemic and dictated by various entities such as national governments, port authorities, and local bodies, posed challenges to crew mobility. In the pandemic's early stages, inconsistencies in these health protocols led to extended onboard stays, with crew contracts lengthened from an initial six months to up to a year. The imposition of varying mandatory quarantine durations further complicated crew-change planning and introduced new hurdles. What was once a 3-day process for routine crew changes expanded to a month or longer, primarily due to added testing, checks, and quarantine measures. Additionally, available seafarers ashore were limited due to similar pandemic-related challenges. Shipping companies' HR departments grappled with reduced staffing owing to infections and quarantines, placing a strain on the remaining personnel and hampering efficient crew management. Extended onboard durations heightened uncertainties and diminished crew morale. Notably, shifting company policies around contract extensions have influenced seafarers' career trajectories and future considerations in the maritime industry. Although crew change operations have largely stabilized post-pandemic, the sector remains without a robust business continuity strategy, especially concerning HR and crew logistics. This absence highlights potential vulnerabilities that could become more pronounced in the face of a similar future crisis.

C2-Implementation of company's safety culture

During the pandemic, the company's safety culture experienced notable challenges, that can be attributed to several key factors. Firstly, the impact on safety culture during the pandemic was largely a result of changes in training methods. The implementation of remote training sessions and the absence of in-person events disrupted traditional training methods. Physical visit restrictions and the closure of external training centres made hands-on, in-person training impossible. This forced the company to rely on alternative methods, primarily remote training and safety meetings, which may not have been as effective or comprehensive. While such remote methodologies may

suffice for soft skill development, they have shown limitations in fostering practical skills and team camaraderie. The lack of in-person events and group training sessions reduced face-to-face interaction, hindering open dialogues and shared experiences essential for a thriving safety culture. Furthermore, building a cohesive safety culture became a challenge in a virtual environment. A strong safety culture relies on shared values and cohesion among employees, which can be more difficult to foster remotely. The transition to remote training also required an adaptation period, during which employees may have faced difficulties in absorbing safety culture messages effectively. These factors collectively underscore the impact of remote training and the absence of in-person events as the primary drivers of deviations in safety culture building and maintenance during the pandemic. Consequently, managing training logistics and offering shore-to-ship supervision, especially involving seasoned professionals like DPAs and technical superintendents, presented significant hurdles in upholding a robust safety culture. As an immediate to mid-term concern, ensuring operational efficiency without jeopardizing crew competency has come to the forefront. Given the increasing adoption of remote training within the maritime industry, there is a need to establish standardized parameters for the scope and extent of such training.

C3-Policies and procedures

During the pandemic, company policies and procedures underwent significant modifications and frequent updates to align with international and national regulations. These revisions predominantly addressed health protocols, crew changes, training, maintenance, inspections, and drydocking, with a central aim of prioritizing safety without compromising operational efficiency. Notable shifts included exemptions for drydocking, prolonged crew contracts, and a heightened dependency on remote training and inspection solutions, all aimed at ensuring consistent operational flow during the COVID-19 period as compared to typical business operations. While the changes concerning contract extensions, planned maintenance, and drydocking were temporary and reverted to their pre-pandemic state, the surge in demand and efficiency of remote training and inspection has consolidated their place as standard practices in the post-COVID-19 maritime landscape.

C4-Crew changes

Crew changes underwent significant disruption during the COVID-19 pandemic, leading to profound alterations in standard procedures. Stringent health protocols, coupled with the limited availability of seafarers due to travel constraints and vaccination requirements, reshaped both the practices and the timelines associated with crew changes. This shift was primarily driven by the ever-evolving nature of health directives and international restrictions. These varied regulations introduced a three-dimensional complexity, involving the port of crew change, country(ies) of transit, and the seafarer's home country. Navigating requirements from these three distinct entities posed a considerable challenge for shipping companies, especially in the absence of harmonized standards. Added to this were increased costs, extended quarantine durations, multiple tests and verifications, and limited flight options, which in some cases extended crew change processes up to tenfold. Consequently, crew contracts were often extended, sometimes lasting two to three times their original terms. Such deviations amplified stress among crew members, adversely affecting their well-being and overall performance. Concurrently, the logistical planning burden on HR departments surged, even as staffing levels remained consistent with pre-pandemic numbers. Post-pandemic, with the decline in COVID-19 cases and widespread vaccination efforts easing restrictions, many changes have reverted to their traditional patterns. However, current deviations, though reduced, remain elevated compared to pre-pandemic standards, largely due to the absence of a standardized, cohesive plan to manage crew changes in the event of a future crisis of similar magnitude.

C5-Provision of supplies, spare parts, maintenance, and drydocking

During the initial stages of the pandemic period, the supply, spare parts, maintenance, and drydocking operations saw significant changes. However, these deviations reduced to a moderate level over the course of the pandemic, as the industry implemented adaptive measures like certificate extensions, dry docking exemptions, and the reopening of air transport and national borders. Throughout the COVID-19 crisis, restricted access to vital ship supplies, such as main engine and auxiliary machinery components, altered operational routines. Infections, quarantines, supplementary testing, PPE requirements, and distancing protocols impeded onboard maintenance performed by the crew. The unpredictability of supply deliveries necessitated strategic planning and a shift towards condition-based maintenance. Additionally, travel limitations curtailed onboard support from shore-based experts, such as DPAs, technical superintendents, and specialists, resulting in diminished oversight and supervisory efficiency. The present state showcases notable improvements, suggesting a comparatively successful recuperation in these operations relative to other areas.

2.4.2 Potential safety issues and emerging risks to shipping from COVID-19

The shipping industry with its complex network of stakeholders and operations was profoundly impacted by the pandemic. A synthesis of information obtained from the interviews and survey questionnaire analyses combined with an exploration of relevant literature, uncovers a set of 18 safety issues and risks that emerged in the wake of COVID-19, as presented below from SI1 to SI18.

- **SI1-Crisis behaviour and safety attitude change:** Extending from previous studies and substantiated by the interview outcomes, there is evidence to believe that extended contracts, limited opportunities for shore leaves, and disrupted daily life routines fostered a potential drift from standard protocols^{47,48} and a transformation in seafarer behaviour. Seafarers experienced prolonged contracts, limited opportunities for shore leaves, lacked access to shore medical facilities, almost no flexibility and opportunity for repatriation, and disrupted routines due to the pandemic. Faced with social distancing measures onboard, seafarers craved better amenities for socialization and psychological relaxation. Those changes have impacted their overall trust (SI9), happiness⁴⁹, levels of stress and chronic fatigue, and sense of being valued and prioritized. The repercussions of these changes pose challenges to maritime safety, mirroring concerns from earlier research where disruptions have historically affected behaviour in crisis situations.
- **SI2-Differential seafarers' transit travel rights:** Disparities in transit travel rights emerged as a highlighted concern, encompassing various aspects such as visa requirements and applications, transit visa mandate based on nationality, COVID-19 vaccination requirements, types of vaccines recognised by the country of origin and country of travel, PCR testing protocols and varying hourly validity for travel permissions. Previous surveys revealed concerns about smooth crew changes and repatriation. The interviews witnessed a reiteration of these concerns, pointing to the additional toll it has taken on crew welfare. Such discrepancies pose not just operational challenges, but also affect the mental well-being of the crew. Unstandardized travel requirements, including nationality-based travel restrictions, although all seafarers carry seaman's book, vaccine availability, and testing protocols, introduces uncertainties and trigger anxiety among seafarers.
- **SI3-Unharmonized regulatory landscape:** The maritime industry has historically been governed by a complex web of overarching international and regional legal and regulatory regime. For instance, within the realm of health and safety, various ports and regions have implemented different health procedures; crew change protocols; health screening and reporting requirements; availability, standards, and quality of quarantine facilities; vaccine distribution; and prioritization of seafarer rights and protections. Furthermore, ship inspections, port state controls, and shipping company's internal audits have also shown significant diversification. Some of these inspections were conducted remotely, while others were delayed or altogether exempted creating different scope and pace of work onboard and ashore. Additionally, crew certificates were extended or renewed through remote training, further highlighting the lack of a harmonized regulatory landscape and actions within the maritime industry. In response, IMO, through its Seafarer Crisis Action Team (SCAT), partnered with organizations such as the International Labour Organization (ILO), the International Transport Workers' Federation (ITF), and the International Chamber of Shipping (ICS) to address individual cases and provide repatriation, medical assistance, working conditions, contracts and certification related support⁵⁰. The literature consistently points to the benefits of harmonized regulatory frameworks. The pandemic has brought to the fore the need for coordination, since unaligned actions risk exacerbating safety concerns while introducing operational challenges.
- **SI4-Changing risk perception:** Both interviews and prior studies indicate a change in the way risks are perceived, even in the larger society. Health uncertainties combined with the evolving operational conditions have catalysed this shift. Seafarers had to reevaluate their understanding of occupational risks, and possible discomforts, encompassing not only traditional maritime safety hazards but also health-related risks during global or regional outbreaks. Having experienced lack of harmonization, seafarers are acutely aware that during global crises and country lockdowns, they can face stranding onboard (even three times more than

⁴⁷ SeatradeMaritime. (2020). Limited shore leave taking its toll on seafarers. <https://www.seatrade-maritime.com/ship-operations/limited-shore-leave-taking-its-toll-seafarers>

⁴⁸ International Chamber of Shipping. (2022). Coronavirus COVID-19 Seafarer Shore Leave Principles 2nd Edition. <https://www.ics-shipping.org/wp-content/uploads/2022/04/Coronavirus-COVID-19-Seafarer-Shoreleave-Principles-Second-Edition.pdf>

⁴⁹ Quarter 1 of 2022 witnessed the lowest levels of seafarer satisfaction for eight years, with the Seafarer Happiness Index measure of overall happiness decreasing from 6.41 to 5.85 and levels dropping across all categories including, connectivity, shore leave, wages, food, fitness, training, interactions, workload, welfare.", The Mission to Seafarers. (2022). Seafarers Happiness Index Quarter 1 2022. <https://www.happyatsea.org/wp-content/uploads/2022/04/Seafarers-Happiness-Index-Q1-2022.pdf>

⁵⁰ IMO. (2023). Seafarer Crisis Action Team: Case studies. <https://www.imo.org/en/MediaCentre/HotTopics/Pages/SCAT.aspx>

contractual period), inability to access medical care ashore, insufficient provisions, especially fresh provisions, restrictions on crew amenities on board, and suspension of shore leaves, intensifying individual concerns about operational and personal safety. Such changes not only challenge decision-making in terms of career planning and affect seafarer supply-demand balance which is in an increasing negative trend since 2019⁵¹ but also impact hazard recognition, a cornerstone of maritime safety. Therefore, more consideration is desirable for health risks, country or region lockdowns etc. in future risk assessments in the maritime domain.

- **SI5-Delayed maintenance:** Maintaining the operational integrity of ships requires regular maintenance. The disruptions of the pandemic have inevitably introduced delays, a concern that literature has previously linked with potential technical and equipment failures. Nearly 60% of the participants from all types of ships indicated that the disruption caused by the pandemic has affected the maintenance and repair of ship equipment and machinery, especially when shore intervention is required. Additionally, travel restrictions and logistical challenges made it difficult to promptly procure spare parts, leading to delays in maintenance and the use of alternatives.

Undoubtedly, inadequate or delayed maintenance can increase wear and tear on equipment, potentially leading to machinery failures and breakdowns at sea. As indicated in the EMSA's annual overview of marine casualties and incidents for 2022, accident events exhibit consistent trends across all ship types, with slight percentage variations. System or equipment failure is the second most dominant accident event following human actions. Furthermore, among the 3032 marine incidents reported globally in 2022 and analysed in the Allianz 2023 Report⁵², machinery damage was identified as the top cause leading to accidents. Additionally, the analysis of marine casualties and incidents from 2012 to 2022 conducted by Lloyd's List Intelligence and DNV⁵³ showed a steady rise in the number of machinery damage or failure incidents. This emerging issue, hints at a looming concern over equipment reliability, particularly, in the short-term post-pandemic recovery period.

- **SI6-Uncharted complex risk landscape:** The post-pandemic era demands a nuanced understanding of risks, especially given the major shifts in operations, regulations, and adoption of new technologies. Earlier studies hinted at the challenges of assimilating emerging technologies. Interviews further illuminated this concern, emphasizing the need for revisiting risk assessments in light of these changes.
- **SI7-Cyber vulnerabilities:** The COVID-19 pandemic, with its subsequent global lockdown measures, acted as a catalyst, significantly expediting the digitalization process across various sectors⁵⁴. This accelerated transformation emphasized the pivotal role of technology in redefining the maritime landscape⁵⁵. Amid this rapid digitalization, maritime organizations found themselves dealing with a new set of challenges especially on digital domain⁵⁶. Safeguarding digital infrastructure became paramount, driven by the escalating threats in cyberspace. Companies had to cultivate proficiency in recognizing and mitigating the growing cyber risks associated with the widespread adoption of technology and its wider implications. Literature has consistently flagged cybersecurity as a budding challenge in an increasingly digitalized maritime industry. The interviews highlighted this concern, with industry insiders acknowledging heightened vulnerabilities, especially with more systems transitioning online during the pandemic. Such vulnerabilities pose potential threats to navigation, communication, and overall maritime safety.⁵⁷
- **SI8-Stress and fatigue:** The psychological toll of the pandemic cannot be understated. Previous studies have highlighted the implications of stress and fatigue on decision-making and the occurrence of casualties and incidents in maritime operations. These concerns were frequently mentioned in the interview responses, highlighting the increased stress levels due to the uncertain climate of the pandemic.

⁵¹ Drewry. (2023). Drewry's Manning Annual Review and Forecast 2023/24 <https://www.drewry.co.uk/maritime-research-products/manning-annual-review-and-forecast-202324>

⁵² Allianz. (2023). Safety and Shipping Review 2023. An annual review of trends and developments in shipping losses and safety. <https://commercial.allianz.com/news-and-insights/reports/shipping-safety.html>

⁵³ Lloyd's list intelligence and DNV. (2022). Maritime safety trends 2012-2022: Advancing a culture of safety in changing industry landscape. https://images.intelligence.informa.com/Web/InformaUKLimited/%7B113f332b-98bd-42be-9455-0d8da6e13e54%7D_LLI-DNV_Report-2023-FINAL.pdf

⁵⁴ Kuhn, K., Bicakci, S. & Shaikh, S.A. (2021). COVID-19 digitization in maritime: understanding cyber risks. *WMU J Marit Affairs* 20, 193–214. <https://doi.org/10.1007/s13437-021-00235-1>

⁵⁵ Yam L. (2021) Technology will help maritime transport navigate through the pandemic-and beyond. <https://blogs.worldbank.org/transport/technology-will-help-maritime-transportnavigate-through-pandemic-and-beyond>

⁵⁶ DNV. (2023). Maritime Cyber Security. <https://www.dnv.com/maritime/insights/topics/maritime-cyber-security/index.html>

⁵⁷ Grasso MI (2020) US Tugboat cyber-attack: the experts respond. <https://www.ship-technology.com/features/cyber-attacks-in-the-maritime-sector-the-experts-respond/>

- **SI9-Erosion of seafarers' trust:** Trust forms the bedrock of any operational setting. The interviews revealed an erosion of this trust, an insight that is supported by literature highlighting the importance of trust in maritime safety. The uncertainties of the pandemic, combined with operational challenges, have potentially undermined effective communication, compliance, and safety reporting.
- **SI10-Timely risk communication:** Prior research has always underscored the value of risk communication in maritime operations. The interviews provided a fresh perspective, highlighting the importance of communicating emerging risks during and following unprecedented crises like the pandemic.
- **SI11-Decrease in collective experience:** The loss of experienced seafarers poses a risk that both interviews (20% of the participants) and literature emphasize. The officer supply and demand statistics indicate an increasing shortfall with 0.5% in 2019, and 9% in 2023⁵⁸. As experienced seafarers exit the workforce, the transfer of critical safety-related knowledge to the next generation becomes compromised, potentially leading to a decline in overall safety standards. Furthermore, the departure of experienced seafarers can create a skills gap that is challenging to bridge. This gap could affect the ability to train and mentor new crew members effectively, hampering their ability to develop the necessary skills and intuition required for safe and efficient ship operations. A decline in collective experience could jeopardize not only operational safety but also nuanced decision-making processes that seasoned seafarers bring onboard.
- **SI12-Maintenance of safety culture:** As presented and explained in SIs 1, 2, 4, 8, 9 above, some of the cultural and mind-set shaping aspects, impacting maritime safety, that eroded during the pandemic, have been a focal point of earlier studies^{59, 60, 61}. Therefore, the issue of maintenance of safety culture resurfaced in the interviews, underscoring the necessity of restoring and maintaining a robust safety culture in maritime. The COVID-19 pandemic has brought to the forefront a series of interconnected safety issues in the maritime industry, each of which underscores the critical importance of maintaining a robust safety culture (SI12). Elevated stress and fatigue levels (SI8) among seafarers, resulting from the pandemic's psychological toll, can erode decision-making and increase the likelihood of incidents. Concurrently, the erosion of seafarers' trust (SI9) due to pandemic-induced operational challenges and uncertainties can undermine effective communication and safety reporting. These challenges have also triggered behavioural changes (SI1) among seafarers, making it essential to reinforce the significance of standardized safety protocols within the industry. Moreover, disparities in transit travel rights (SI2) due to variations in visa requirements and COVID-19 restrictions introduce uncertainties and anxiety. A strong safety culture becomes the anchor to navigate these complexities while prioritizing seafarer well-being. The evolving risk perception (SI4) among seafarers, emphasizing health-related risks alongside traditional safety hazards, necessitates a safety culture that encourages proactive risk assessment and adaptation. Being correlated and linked with other issues, SI12 serves as the key to addressing these interconnected challenges, reinforcing trust, managing stress, coping with behavioural changes, and adapting to evolving risk perceptions while maintaining safety in maritime operations.
- **SI13-Restructured supply chain and accessibility to supplies:** The cascading effects of a disrupted supply chain touch various facets of maritime operations. While literature has explored the implications of supply chain challenges in isolation, the interviews offered insights into the post-pandemic restructuring and its implications for maritime safety. A major safety concern emerged from this restructuring due to the unavailability and closure of Original Equipment Manufacturers (OEM) and suppliers especially during COVID-19, compelling shipping companies to seek alternative suppliers and establish efficient logistics with new partners. Unfortunately, in the majority of cases, this process led to increased supply costs compared to established arrangements with previous suppliers. The interviews indicated that in 20-30% of the attempts, supplying ships became impossible due to ongoing supply chain disruptions during COVID-19 and closure of OEMs/suppliers. In such crisis situations, the inability to provide critical supplies can precipitate incidents and accidents. Therefore, the evolution and restructuring of the supply chain must be recognized as a safety issue of

⁵⁸ Drewry. (2023). Drewry's Manning Annual Review and Forecast 2023/24 <https://www.drewry.co.uk/maritime-research-products/manning-annual-review-and-forecast-202324>

⁵⁹ Lucas, D., Jegou, C., Jensen, O. C., Loddé, B., Pougnet, R., Dewitte, J. D., Sauvage, T. & Jegaden, D. (2021). Seafarers' mental health in the COVID-19 era: lost at sea? *International maritime health*, 72(2), 138-141.

⁶⁰ Quarter 1 of 2022 witnessed the lowest levels of seafarer satisfaction for eight years, with the Seafarer Happiness Index measure of overall happiness decreasing from 6.41 to 5.85 and levels dropping across all categories including, connectivity, shore leave, wages, food, fitness, training, interactions, workload, welfare." *The Mission to Seafarers*. (2022). Seafarers Happiness Index Quarter 1 2022. <https://www.happyatsea.org/wp-content/uploads/2022/04/Seafarers-Happiness-Index-Q1-2022.pdf>

⁶¹ Baygi, F., Mohammadian Khonsari, N., Agoushi, A., Hassani Gelsefid, S., Mahdavi Gorabi, A., & Qorbani, M. (2021). Prevalence and associated factors of psychosocial distress among seafarers during COVID-19 pandemic. *BMC psychiatry*, 21(1), 222.

paramount importance, especially with regard to ensuring the availability and reliable supply of critical safety and machinery equipment/spares.

- **SI14-Impact on teamwork:** Collaboration remains paramount in maritime settings. Interviews revealed that altered schedules and the remote work dynamic have posed challenges to effective teamwork, a concern that resonates with literature emphasizing the value of coordinated efforts in maritime operations.
- **SI15-Challenges in resilience testing:** Proactive resilience assessments are pivotal. Literature has long emphasized the importance of pre-emptive testing, and interviews reaffirmed this, emphasizing the risk of awaiting another crisis for resilience evaluation.
- **SI16-Maintenance of skills and competency:** Skills degradation, a concern flagged in prior research^{62, 63, 64}, was revealed to be even more pronounced in the interviews. The pandemic's disruptions, including reduced onboard drills and remote training, potentially compromise situational awareness, task execution, and decision-making. With restrictions on crew movement, quarantine protocols, and social distancing measures, conducting on board drills became logistically challenging during the pandemic. As a result, there was a reduction in the practice and assessment of critical safety procedures, which encompass various aspects such as fire-fighting, abandon ship drills, and handling hazardous materials. Another contributing factor to skills degradation is the shift towards remote training and learning. While remote learning methods have been increasingly adopted in various industries, including maritime, the abrupt transition during the pandemic may not have been as effective as traditional in-person training. The practical and hands-on nature of seafaring demands a certain level of physical presence and interaction. Remote training cannot fully replicate the experience and knowledge transfer that occurs during onboard, face-to-face training sessions. This shift has hindered the development of practical skills and real-world problem-solving capabilities. The potential consequences of skills degradation are significant. The erosion of practical skills directly affects safety within the maritime context⁶⁵. The compromised knowledge base, altered behaviour, and negative attitude collectively contribute to an increased risk of accidents, incidents, and operational disruptions due to increased probability of human error. EMSA's annual overview of marine casualties and incidents 2022⁶⁶ indicates that between 2019-2021, 52.2% of the accident events were linked to human actions. Furthermore, 45.1% of the human factors focused safety recommendation actions are in the area of training, skills and experience.
- **SI17-Resource constraints:** Limited resources, whether due to supply chain disruptions or reduced budgets, can stymie essential aspects like maintenance and safety training. Both literature and interviews spotlighted these constraints, particularly highlighting the challenges for smaller companies with limited resources.
- **SI18-Lost opportunity of knowledge transfer:** The potential premature exit of experienced seafarers introduces a knowledge gap, a concern both literature and interviews emphasize. This deprives newer seafarers of invaluable insights, risking a loss of collective expertise.

An appraisal of the interrelation between the identified emerging risks and potential safety issues is made using two separate approaches from literature – influence diagram and Rasmussen's risk management framework.

⁶² Medina, J. (2021). Real Decisions in Virtual Waters. A Mixed Methods Study on the Fit Between Technology-Based Training and the Seafarers' Tacit Knowledge Transfer of Cognitive Decision-Making Skills (Doctoral dissertation, Northcentral University).

⁶³ Aylward, K., Weber, R., Lundh, M., MacKinnon, S. N., & Dahlman, J. (2022). Navigators' views of a collision avoidance decision support system for maritime navigation. *The Journal of Navigation*, 75(5), 1035-1048.

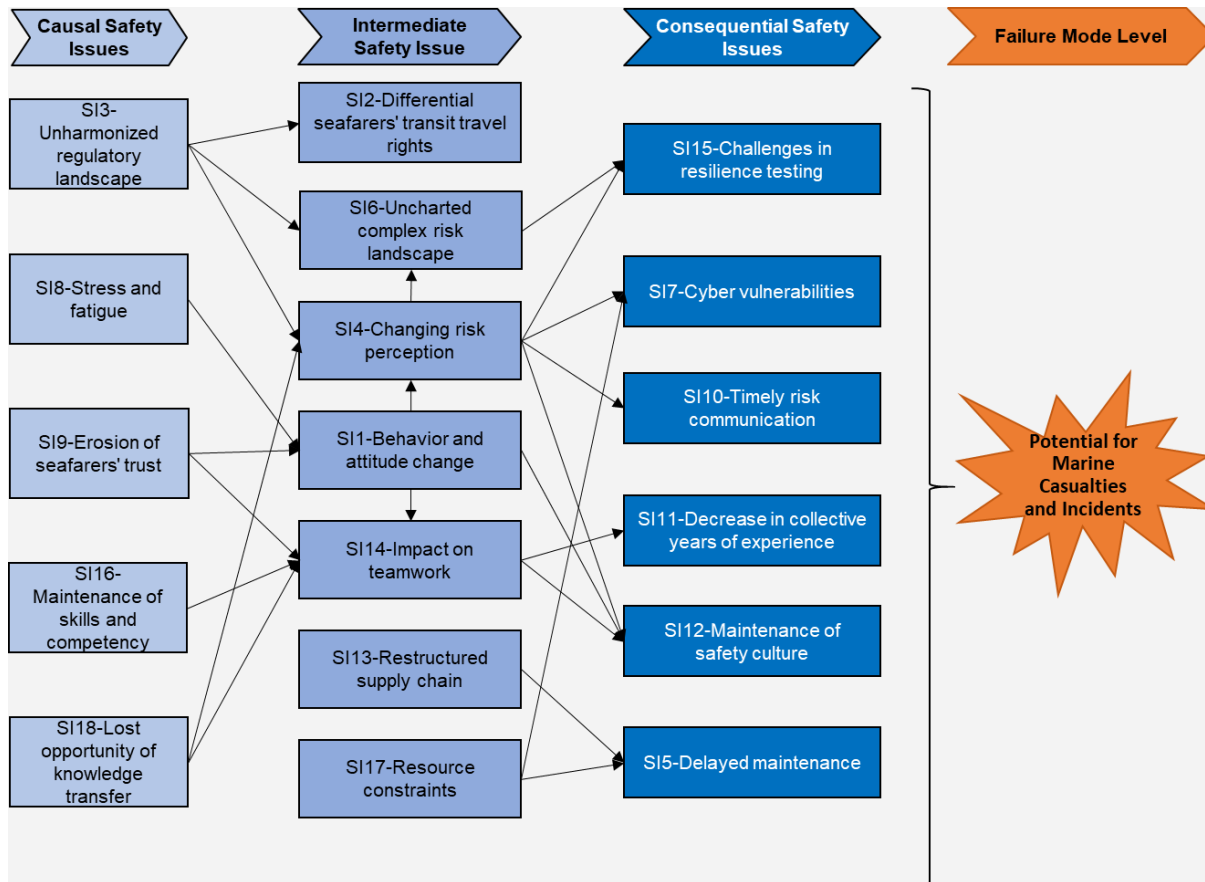
⁶⁴ Tam, K., Hopcraft, R., Crichton, T., & Jones, K. (2021). The potential mental health effects of remote control in an autonomous maritime world. *Journal of International Maritime Safety, Environmental Affairs, and Shipping*, 5(2), 40-55.

⁶⁵ Knowledge Behavior Attitude theory

⁶⁶ EMSA. (2022). Annual overview of marine casualties and incidents 2022. <https://www.emsa.europa.eu/fc-default-view/download/7362/4867/23.html>

Appraisal of safety issues: influence diagram approach

Figure 18: Interaction of emerging risks and potential safety issues



The several safety issues identified in this study, within the maritime industry, are interconnected, emphasizing the importance of addressing these challenges collectively. Figure 18 presents the interdependence among the safety issues with a perspective of “causal safety issues” influencing the occurrence of “intermediate safety issues” and “consequential safety issues”. It can be observed that, an Unharmonized regulatory landscape (SI3) and resulting double standards between seafarers to access shore leave, repatriation, receiving non-urgent medical assistance ashore etc. leads to differential seafarers' transit travel rights (SI2), a major safety issue, which is intermediate in nature. At the same time, regulatory disparities also make it challenging to navigate a complex and unpredictable risk landscape (SI6) especially during global or regional outbreaks (health, political conflicts etc.) which can present challenges in resilience testing (SI15). When the regulatory landscape is complex, hazards are not clearly defined and risks are dynamic testing an organization's resilience becomes more difficult.

Stress and fatigue (SI8), and erosion of seafarers' trust (SI9) are causal safety issues that can result in behaviour and attitude change (SI1), which can, in turn, impact the maintenance of safety culture (SI12). Additionally, behaviour and attitude change (SI1) can directly affect risk perception (SI4) because risk recognition and safety behaviour are closely connected.

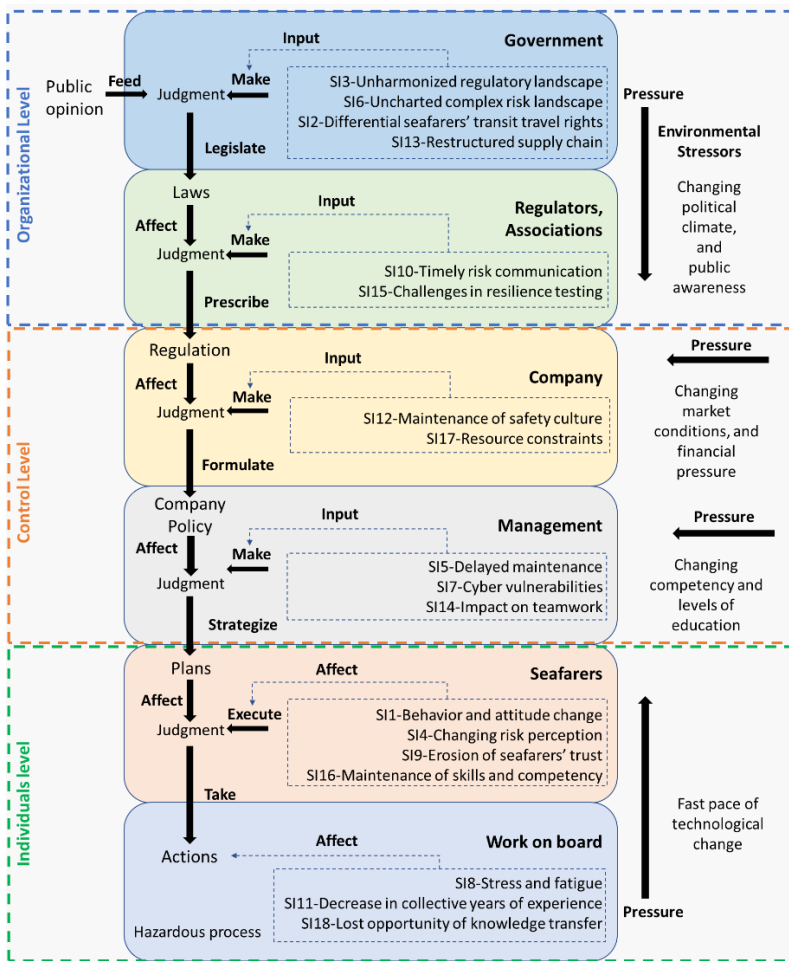
Maintenance of skills and competency (SI16) is yet another causal safety issue that can negatively impact on teamwork (SI14), which, in turn, affects maintenance of safety culture (SI12). This chain suggests that the competence of individuals plays a crucial role in shaping teamwork, which subsequently impacts the overall safety culture which is one of the well-known and widely accepted causal factors in the literature, leading to marine incidents. Lost opportunity of knowledge transfer (SI18) leads to a negative change in risk perception (SI4), and this shift in risk perception can result in increased vulnerability to novel threats such as cyber vulnerabilities (SI7). Similarly, lost opportunity of knowledge transfer (SI18) influencing risk perception (SI4) can also affect the timely communication of risks (SI10) due to the blockage of the learning from experiences. When risk perception changes, the communication of risks to relevant parties may not happen as effectively or promptly. The lack of knowledge transfer opportunities further can erode efficient and harmonious teamwork, on board and within the organization, which, in turn, affects the organization's overall safety culture.

Resource constraints (SI17) can lead to delayed maintenance (SI5). Limited resources may result in delays in maintenance activities. Furthermore, resource constraints (SI17) can result in increased exposure to cyber vulnerabilities (SI7) because cyber security requires investment. When resources are limited, an organization may become more susceptible to cybersecurity threats. Restructured supply chain (SI13), mainly due to unavailability of previously established suppliers and challenges in finding new reliable suppliers, can also contribute to delayed maintenance (SI5). Changes in the supply chain can cause delays and ultimately impact the timely execution of maintenance tasks and pave the way for sudden failures/damages in equipment.

Appraisal of safety issues: Rasmussen’s framework

In the realm of understanding and managing risks within complex systems, the risk management framework developed by Rasmussen offers a multi-layered perspective, diving deep into the intricacies of risk from broader societal influences down to individual human factors. The framework delineates the interactions between various levels, ranging from the macro environment of economic, political, and regulatory influences to the micro level of individual human actions and behaviours. By situating emerging risks and potential safety issues within this framework, the study aims to provide an overview of how these concerns interface with different facets of the maritime sector. Figure 19 integrates identified risks into Rasmussen's model, offering a structured insight into the multifaceted challenges posed by the ongoing pandemic and its implications for maritime safety. The categorization is made by considering the origin of the emerging safety issue and the influencing factors from different stakeholder group included in the Rasmussen’s framework.

Figure 19: Appraisal of the emerging risks and potential safety issues using Rasmussen’s risk management framework



In conclusion, the myriad emerging safety issues and risks that came to the fore during the pandemic underscore the intricate dynamics of maritime operations amidst global uncertainties. While it is imperative to deal with these immediate concerns, it is equally vital to discern their persistence over time. Section 2.4.3 will involve assessing whether these identified safety issues would be temporary or likely to prevail in the longer term.

2.4.3 The degree of transience of the detected safety issues and emerging risks

Maritime operations, by virtue of their global expanse and complex network with geopolitical, socio-economic, and environmental realities, find themselves susceptible to ripple effects from events like the COVID-19 pandemic. Therefore, it would not suffice to limit the study to a diagnosis of the safety issues and emerging risks; it would also be crucial to gauge their temporal dimension. In simpler terms, are the identified risks merely fleeting challenges of troubled times, or do they portend more profound, enduring shifts in maritime safety paradigms?

Expert workshop for temporal insights on the identified emerging risks

With a view to achieve more granular insights into the temporal aspects, an expert workshop was conducted. The workshop benefited from the participation of a wide cross-section of maritime stakeholders, including 5 shipboard personnel and 10 senior management personnel of companies. Each expert was presented with the list of detected safety issues and emerging risks and asked to rate the likely significance of the risks on a Likert scale ranging from 0 (no significance), 1-3 (low) 4-6 (moderate), 7-9 (high) and 10-12 (very high) over three broad time horizons: short-term (<1 year post pandemic), mid-term (1-3 years post pandemic), and longer-term (>3 years post pandemic). Table 9 presents a distilled view of the results regarding the degree of transience.

Table 9: The degree of transience of the detected safety issues and emerging risks

Potentially emerging safety issue	Short-term		Mid-term		Longer-term	
	Shipboard	Company	Shipboard	Company	Shipboard	Company
SI1-Behavior and attitude change	10	6	8	5	6	3
SI2-Differential seafarers' transit rights	10	9	8	8	6	6
SI3-Unharmonized regulatory landscape	9	9	7	7	5	6
SI4-Changing risk perception	9	7	7	7	5	5
SI5-Delayed maintenance	8	6	7	6	5	5
SI6-Uncharted complex risk landscape	8	8	7	7	6	7
SI7-Cyber vulnerabilities	8	8	7	8	6	7
SI8-Stress and fatigue	8	6	6	5	6	4
SI9-Erosion of seafarers' trust	7	6	6	4	5	2
SI10-Timely risk communication	7	7	7	6	5	5
SI11-Decrease in collective experience	7	7	7	6	6	5
SI12-Maintenance of safety culture	6	6	5	5	4	4
SI13-Restructured supply chain	6	6	6	6	4	4
SI14-Impact on teamwork	6	4	5	4	5	4
SI15-Challenges in resilience testing	6	6	5	6	4	5
SI16-Maintenance of skills/ competency	6	5	5	5	5	5
SI17-Resource constraints	5	6	4	5	3	3
SI18-Lost knowledge transfer opportunity	5	5	5	5	5	5

Significance scale	No significance (0)	Low significance (1-3)	Moderate significance (4-6)	High significance (7-9)	Very high significance (10-12)
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Interpretation of workshop results on transience of the identified risks

The insights from the expert workshop helped this study to evaluate the degree of transience of each identified safety issue. The temporal categorization based on significance of each emerging risk aims to provide a roadmap for stakeholders to prioritize interventions and allocate resources effectively – immediate issues should be addressed swiftly, while strategies and implementation plan should be developed for the mid-term and longer-term concerns to ensure that the maritime realm remains robust and resilient.

Based on the results of the expert survey (Table 9), a 3-factor categorization of the detected safety issues based on the significance and degree of transience is presented in Table 6. Category 1 includes safety issues of very high significance with impact in short and mid-term and therefore requiring full and urgent attention and resources for addressing mitigation measures. Category 2 covers safety issues with high impact extending up to mid-term requiring high attention and immediate resources. Category 3 covers complex safety issues with high impact with persistence over longer term timeframes and, therefore, requiring high investment and high, sustained attention. The uncategorised safety issues bear moderate and low significance and may be addressed as deemed fit with no specific timeframe. Table 10 summarizes the structured framework for addressing the detected safety issues and emerging risks. A discussion on the transience of the individual safety issues as per their category follows.

Table 10: Categorization of emerging risks as per significance and degree of transience

Mitigation category	Mitigation strategy	Target safety issue
Category 1 <i>Significance: very high</i> <i>Transience: short to mid-term</i>	full and urgent attention and urgent resources	<ul style="list-style-type: none"> ▪ SI1-Behavior and attitude change ▪ SI2-Differential seafarers' transit travel rights
Category 2 <i>Significance: high</i> <i>Transience: short to mid-term</i>	high attention and immediate resources	<ul style="list-style-type: none"> ▪ SI3-Unharmonized regulatory landscape ▪ SI4-Changing risk perception ▪ SI5-Delayed maintenance ▪ SI8-Stress and fatigue ▪ SI9-Erosion of seafarers' trust ▪ SI10-Timely risk communication ▪ SI11-Decrease in collective years of experience
Category 3 <i>Significance: high</i> <i>Transience: persistent</i>	high investment and high, sustained attention due to complex nature of risk	<ul style="list-style-type: none"> ▪ SI6-Uncharted complex risk landscape ▪ SI7-Cyber vulnerabilities
Uncategorized <i>Significance: moderate to low</i> <i>Transience: persistent</i>	may be addressed as deemed fit with no specific timeframe	<ul style="list-style-type: none"> ▪ SI12-Maintenance of safety culture ▪ SI13-Restructured supply chain ▪ SI14-Impact on teamwork ▪ SI15-Challenges in resilience testing ▪ SI16-Maintenance of skills and competency ▪ SI17-Resource constraints ▪ SI18-Lost opportunity of knowledge transfer

Transience of category 1 safety issues and emerging risks

- **SI1-Behavior and attitude change:** The acute behavioural impacts were most pronounced in the pandemic's early stages. Immediate behavioural impacts were prominently observed at the shipboard level. However, the residual effects seem to diminish over time, especially at the ashore company level, and expected to stabilize in the longer-term.
- **SI2-Differential seafarers' transit travel rights:** A concern that is expected to be addressed as global regulations adapt. The substantial drop over time perhaps anticipates global regulatory alignments and better rights frameworks in the post-pandemic era, at least in the mid-term.

Transience of category 2 safety issues and emerging risks

- **SI3-Unharmonized regulatory landscape:** The push for cohesive regulatory mechanisms becomes stronger in this phase. The acute realization during the pandemic's onset might slowly give way to more harmonized measures, yet the call for cohesive regulatory mechanisms remains strong.
- **SI4-Changing risk perception:** As the pandemic narrative evolves, so does risk assessment. The acute realization in the short to mid-term period hints at adaptability in risk assessment methods. As the pandemic's narrative develops, the risk perceptions are projected to stabilize, but not entirely fade away.

- **SI5-Delayed maintenance:** Immediate disruptions caused maintenance backlogs. Though the urgency decreases over time, the legacy of delayed maintenance could have a mid-term undercurrent affecting operational efficiency and safety onboard ship.
- **SI8-Stress and fatigue:** While the immediate aftermath of the pandemic spiked stress and fatigue levels, the gradual decrease in scores is hopeful, anticipating better-coping mechanisms and support structures.
- **SI9-Erosion of seafarers' trust:** Initial uncertainties eroded trust among seafarers. The declining trend may hint at recovery and rebuilding of trust, but the initial blow to seafarer's confidence during the pandemic's peak remains noteworthy.
- **SI10-Timely risk communication:** The emphasis on clear, timely communication persists, highlighting the ongoing need for transparency throughout recovery.
- **SI11-Decrease in collective years of experience:** In the mid-term perspective, the loss of experienced seafarers is expected to remain as a pressing concern, and even as time progresses indicating a lasting impact on the accumulated years of experience in the industry.

Transience of category 3 safety issues and emerging risks

- **SI6-Uncharted complex risk landscape:** The maritime industry's response to COVID-19 necessitates a comprehensive examination of risks, encompassing operational changes (such as increased digitalization and remote operations), regulatory adjustments (involving seafarers' travel facilitation, access to onshore medical care, recognition as essential workers, and the issuance of necessary authorizations), as well as the incorporation of new technologies (including autonomy and digital data sharing), and updated procedures. These components, which include COVID-19-related factors like health risks, emergency situations, lockdowns, quarantines, and vaccine recognition, introduce a complex array of safety concerns. The maritime industry recognizes the evolving risk landscape, with concerns slightly waning but not disappearing, emphasizing a vigilant, adaptive approach.
- **SI7-Cyber vulnerabilities:** With an increasing shift to digitalization, cybersecurity becomes paramount. As digital interactions become commonplace, this concern remains pertinent, even in the longer-term.

Transience of uncategorized safety issues and emerging risks

- **SI12-Maintenance of safety culture:** A decline in certain aspects of safety culture indicates that the maritime sector will likely prioritize the reinstatement of its established safety culture.
- **SI13-Restructured supply chain:** Following the initial pandemic-related disruptions, there is an expectation for supply chains to realign in the post-pandemic.
- **SI14-Impact on teamwork:** The pandemic's immediate effects, such as lockdowns, disrupted teamwork. However, as challenges persist, innovative modes of collaboration may emerge to alleviate the initial setbacks.
- **SI15-Challenges in resilience testing:** There's a growing recognition of the necessity of resilience, especially as the industry moves into a recovery phase. Uniform concerns across timeframes emphasize the continual importance of gauging and reinforcing resilience, no matter the phase of the crisis.
- **SI16-Maintenance of skills and competency:** Continuous skill and training needs in the ever-evolving maritime industry. In the dynamic maritime industry, there is an ever-present demand for continuous skill development and training.
- **SI17-Resource constraints:** Immediate supply chain disruptions posed significant challenges. The gradual reduction may be attributed to supply chains and resource networks realigning and stabilizing post disruptions.
- **SI18-Lost opportunity of knowledge transfer:** The importance of knowledge continuity remains a steady concern, emphasizing the importance of knowledge continuity in maritime operations.

While the temporal dimensions of the aforesaid issues vary, they jointly script a narrative of a maritime industry in flux, striving for stability and safety amidst unprecedented challenges. The evolving nature of these challenges necessitates a dynamic, responsive strategy, ensuring that the maritime realm remains resilient against both immediate disruptions and long-term paradigm shifts.

Regardless of the prioritization, one significant fact which clearly emerges from the results of the expert workshop is that the residual impacts of the COVID-19 pandemic will likely impinge on maritime safety for a long time to come. In other words, owners, operators, regulators, and other stakeholders should continue to pay close attention to the evolution of risks vis-à-vis implemented mitigation measures over mid- to long term.

The next section will delve into understanding possible precursors to these issues, providing early-warning mechanisms to pre-empt and mitigate the identified risks.

2.4.4 Possible precursors of safety issues and emerging risks

In order to understand the depth and complexity of maritime safety, it is essential to explore the potential precursors that might act as early warning signals of emerging risks. These precursors, when identified early, can aid in preventing more significant challenges or unsafe events in the future. By mapping each emerging safety issue to its precursor, it is aimed to develop a clearer view of the holistic landscape. In the light of the data gathered from interviews, workshops, and literature, the following potential precursors for the detected safety issues were identified (Table 11).

Table 11: Possible precursors of select safety issues and emerging risks

Emerging Safety Issue	Potential Precursor(s)
SI1-Behaviour and attitude change	<ul style="list-style-type: none"> ▪ Increase in the number of interpersonal conflicts on board ▪ Negative feedback from psychological assessment tests ▪ Increase in reported safety and operational protocol variabilities ▪ Decline in job satisfaction survey scores ▪ Deterioration in crew communication quality
SI2-Differential seafarers' transit travel rights	<ul style="list-style-type: none"> ▪ Increase in the number of crew stranded in foreign ports ▪ Increase in the amount of time, spent/dedicated to processing travel documents required for repatriating crew members at a given port ▪ Increase in the number of seafarer abandonment cases related to repatriation
SI3-Unharmonized regulatory landscape	<ul style="list-style-type: none"> ▪ Increase in disputes or appeals relating to vessel detentions or penalties ▪ Negative feedback from ship operators about challenges in adhering to differing standards when transitioning between jurisdictions
SI4-Changing risk perception	<ul style="list-style-type: none"> ▪ Discrepancies in safety reporting such as near miss reporting ▪ Increase in reported safety and operational protocol variabilities
SI5-Delayed maintenance	<ul style="list-style-type: none"> ▪ Increase in number of equipment failures ▪ Increase in number of equipment malfunction reports ▪ Extensions in maintenance schedules ▪ Delays in onboard planned maintenance ▪ Increase in number of incidents attributed to equipment failures ▪ Increase in safety related critical equipment deficiencies during inspections (e.g., flag State, port State) such as fire detection and fighting equipment
SI6-Uncharted complex risk landscape	<ul style="list-style-type: none"> ▪ Rapid involvement of technological adaptations such as new fuels, digitalization, autonomous vessels, and other precursors can be specific to the operations
SI7-Cyber vulnerabilities	<ul style="list-style-type: none"> ▪ Increase in the number of system glitches recorded over time ▪ Increase in the reports of suspicious online activities ▪ Unusual network traffic patterns ▪ Delays and disruptions in operations due to IT related issues
SI8-Stress and fatigue	<ul style="list-style-type: none"> ▪ Increase in the number of interpersonal conflicts on board ▪ Negative feedback from psychological assessment tests ▪ Increase in the frequency of the use of sick leave or medical consultations ▪ Increase in the number of near miss incidents due to attention lapses ▪ Increase in the number of incidents attributed to navigation or equipment handling errors
SI9-Erosion of seafarers' trust	<ul style="list-style-type: none"> ▪ Discrepancies in safety reporting such as near miss reporting ▪ Decline in job satisfaction survey scores ▪ High turnover rates, low retention rates

SI10-Timely risk communication	<ul style="list-style-type: none"> ▪ Increase in the number of incidents attributed to unawareness of the hazards or risk, and other precursors specific to the operations
SI11-Decrease in cumulative years of experience	<ul style="list-style-type: none"> ▪ High turnover rates, low retention rates ▪ Lower average years of experience in crew
SI12-Maintenance of safety culture	<ul style="list-style-type: none"> ▪ Increase in reported safety and operational protocol variabilities ▪ Negative feedback from safety culture surveys
SI13-Restructured supply chain	<ul style="list-style-type: none"> ▪ Increase in equipment procurement times, delays ▪ Feedback on supplier reliability ▪ Other precursors specific to the operations affected by the supply chain
SI14-Impact on teamwork	<ul style="list-style-type: none"> ▪ Increase in the number of incidents attributed to communication gaps and team coordination (bridge team or engineering team) ▪ Increase in task redundancies based on supervisors' feedback ▪ Deterioration in crew communication quality
SI15-Challenges in resilience testing	<ul style="list-style-type: none"> ▪ Availability of the resilience plans and actions of maritime stakeholders (shipping companies, governments, ports, etc.) against crises and disruptions, and other precursors specific to the operations
SI16-Maintenance of skills and competency	<ul style="list-style-type: none"> ▪ Increase in the number of deficiencies and remarks in inspections related to crew performance during safety drills and other safety emergencies ▪ Increased number of incidents attributed to human error particularly skills and competency related
SI17-Resource constraints (impact on safety investment)	<ul style="list-style-type: none"> ▪ Delays in safety equipment replacements ▪ Reports of insufficient onboard resources ▪ Reduction in safety investment of maritime stakeholders ▪ Reduced availability of crew amenities onboard
SI18-Lost opportunity of knowledge transfer	<ul style="list-style-type: none"> ▪ Delays and disruptions in operations attributed to the lacking in familiarization ▪ Increased number of incidents attributed to lack of familiarization ▪ High turnover rates ▪ Low retention rates (early retirement or move to shore-based jobs)

While Table 11 provides a list of potential precursors by safety issues and emerging risks, it is important to emphasize the necessity of tailoring these indicators to the specific maritime operations taking into account the baseline indicators identified in Tables 2 and 3.

Pilotage for instance, involves seasoned pilots guiding ships through challenging or potentially hazardous waters, especially during their entry or exit from ports. In this context, "behaviour and attitude change" can be relevant when there is an increase in interpersonal conflicts between pilots and ship crews or when there is a noted deviation from set navigation protocols. The precursors for "stress and fatigue" are also vital here, given that pilots operating in high-traffic ports may face intense schedules, increasing the chances of navigation errors due to attention lapses. Furthermore, "unharmonized regulatory landscape" precursors can manifest in pilotage as inconsistencies in navigation protocols or best practices between different ports or regions, leading to potential confusion or misinterpretation of essential procedures.

Crew change, as another example, entails the rotation of ship personnel, marking the end of their on-board duty and the beginning of a fresh set. In such scenarios, "differential seafarers' transit travel rights" is particularly salient, given that there have been numerous reports of crew stranded in foreign ports due to inconsistent travel policies across countries. This could further lead to undue stress, causing a decline in crew performance and well-being, all of which can be precursors among other parameters listed in the baseline section.

These two examples underscore the importance of adapting the generic precursors to fit the unique challenges and operational nuances of specific maritime activities as presented in the baseline. Such adaptation ensures that these precursors are both relevant and actionable in anticipating and mitigating potential risks.

Concluding this section, it is evident that the early detection of potential safety issues through these precursors is pivotal for maritime safety. By cultivating a proactive stance, the maritime industry can foresee challenges and adapt accordingly, ensuring the continuity, efficiency and safety of operations.

The next section will explore how these safety issues and emerging risks are likely to evolve, especially within the specific clusters of ships considered in the study.

2.4.5 Evolution of safety issues and emerging risks

The maritime domain, characterized by its varied fleet and intricate operations, continually adapts to meet evolving challenges. Each ship type, with its unique design and operational framework, inherently displays varied responses to both internal and external disruptions. Such differences become particularly pronounced when facing systemic events, such as the COVID-19 pandemic. The overall impact of COVID-19 on specific ship types was obtained through a structured process that associated the magnitude of safety issues with different types of ships, distinguishing between very high, high, moderate, and low impact.

Expert survey of the impact of safety issues and emerging risks

A structured online questionnaire was used to conduct an expert survey of all 18 detected safety issues and emerging risks (see Annex). Based on voluntary participation, a total of 45 expert participants, including 12 with experience on dry/general cargo ships, 13 on tankers, 10 on container ships, and 10 on passenger ships provided responses. Each expert assessed the impact of specific safety issues on the type of ship they had recent experience with. A scoring system was utilized, ranging from 1 to 12, where 1-3 denoted low impact, 4-6 signified moderate impact, 7-9 represented high impact and 10-12 indicated very high impact. Participants provided their rating for each safety issue's impact on their respective ship types, resulting in the matrix presented in Table 12 as per the average impact score.

Table 12: Impact of safety issues and emerging risks on different type of ships

Emerging Safety Issue	Passenger ships	Container ships	Dry/General cargo ships	Tanker ships
SI1-Behaviour and attitude change	8.5	6.3	8.0	7.2
SI2-Differential seafarers' transit rights	8.0	7.8	8.8	8.8
SI3-Unharmonized regulatory landscape	7.5	8.8	8.6	7.6
SI4-Changing risk perception	8.5	7.5	7.8	6.0
SI5-Delayed maintenance	10.5	6.3	7.9	6.3
SI6-Uncharted complex risk landscape	7.5	7.8	6.8	5.1
SI7-Cyber vulnerabilities	9.0	7.5	5.7	6.0
SI8-Stress and fatigue	9.0	9.8	9.8	8.5
SI9-Erosion of seafarers' trust	8.0	8.3	8.5	6.1
SI10-Timely risk communication	7.0	8.2	7.8	6.5
SI11-Decrease in collective experience	8.0	9.3	8.0	8.4
SI12-Maintenance of safety culture	6.5	6.3	8.2	5.7
SI13-Restructured supply chain	4.0	8.0	8.0	5.6
SI14-Impact on teamwork	9.0	4.8	6.9	5.1
SI15-Challenges in resilience testing	5.5	8.3	7.9	6.0
SI16-Maintenance of skills and competency	5.5	7.3	8.1	5.9
SI17-Resource constraints	11.5	8.1	8.0	6.4
SI18-Lost opportunity of knowledge transfer	7.5	5.8	7.9	5.8

Scale		
Low (1-3)		Minor operational impacts, few safety concerns
Moderate (4-6)		Some operational inefficiencies, moderate safety concerns
High (7-9)		Noticeable disruptions in operations, considerable safety concerns
Very high (10-12)		Major operational disruptions, significant safety concerns

Interpreting the survey results for ship-type-specific vulnerabilities to emerging risks

Given the unique attributes of every ship type, in terms of operational nuances and crewing configurations, each possesses specific susceptibilities. Providing a tentative overview across ship types necessitates an understanding of the inherent vulnerabilities each type may hold. The expert survey set the stage for a more comprehensive evaluation. The ensuing discussion on the impact on the individual ship types draws on the results of the expert survey. This step aimed to present an evaluation of the safety issues and their impacts, further aids in the effective prioritization of risk mitigation measures for different ship types.

- **Passenger ships:** These vessels are distinctive for their human-centric operations. Being a direct service provider to a large number of passengers, their design and functionality prioritize human safety and comfort. However, this characteristic also makes them particularly vulnerable in situations of global health crises, such as a pandemic. Resource constraints (SI17) can have a very-high impact on passenger ships. Managing limited resources effectively is a critical challenge for this ship category, especially when it comes to implementation of enhanced safety protocols for ensuring passenger safety during a health crisis. Delayed maintenance (SI15) can cause an equally high impact on safety of passenger ships, particularly due to the potential consequences of delayed maintenance such as sudden blackouts, malfunctions and breakdowns on ship's main machinery, and equipment. Ensuring timely maintenance is crucial to prevent safety risks and disruptions, especially given the concentration of passengers, and quick turnaround times in intensive schedules. Besides, even relatively shorter delays and lay-up of six months to a year, can result in high degradation in ship's condition. Further, cyber vulnerabilities (SI7) are of great concern, given the significant numbers lives at risk in case of a cyber-incident affecting the ships control systems. This is besides the need to safeguard passenger information, including personal ID, passport scans, contactless payment systems and services and potential data security vulnerabilities. On the crew side, stress and fatigue (SI8) with consequent negative impact on teamwork (SI14) points to the importance of maintaining effective teamwork on passenger ships for harmonious and coordinated operations.
- **Container ships:** Integral to global supply chains, container vessels transport a vast array of goods, highlighting their importance in maintaining economic flow. Their operations are closely tied to ports, customs, and land-based logistics, making them susceptible to disruptions like unharmonized regulations. Additionally, their high-demanding nature for physical work (lashing and cargo securing, continuous check for proper loading of containers on board) makes container ships vulnerable to human centric safety issues. According to the survey results, the safety issue with the highest impact is stress and fatigue (SI8), emphasizing the need to address crew well-being for optimal performance and safety in the fast-paced world of container shipping. Since continuous stress and fatigue can trigger seafarers to shift to land-based jobs, the decrease in collective years of experience (SI11) is a critical issue, underlining the importance of the necessity of maintaining an experienced crew for effective and safe operations by increasing the retention rates and reducing the turnover rate. In addition, the unharmonized regulatory landscape (SI3) has a significantly high impact on container ships, due to their high frequency of port of calls and fast pace, highlighting the importance of standardized regulations (health protocols, travel requirements, places of refuge for health emergencies etc.) to ensure efficient and safe operations in a future crisis.
- **Dry/general cargo ships:** Known for their versatility, these vessels can carry diverse cargo types, catering to varied trading needs. Their adaptability, though an advantage, also opens doors to a wide range of operational challenges. According to the experts on dry/general cargo ships, stress and fatigue (SI8) is the safety issue with the highest impact. Ensuring crew well-being is crucial for efficient and safe operations, given their multifaceted cargo-carrying responsibilities and longer contract and sailing durations compared to other types. Differential seafarers' transit travel rights (SI2) are also a significant issue for these ships, highlighting the need for equitable regulations to govern the movements of seafarers. Similarly, the unharmonized regulatory landscape (SI3) is a major concern with high impact, underscoring the necessity of standardized regulations, especially for travel rights, prioritization of seafarers, recognition of seaman's book as a travel document, to facilitate and maintain the pre-planned crew change operations during global or regional emergencies (health or political). Likely stemming from the prolonged periods spent on board during the COVID-19 pandemic (in many cases 2 to 3 times the contractual obligation, and exceeding the limits prescribed in MLC), the erosion of seafarers' trust (SI9) is another issue of significant impact on dry/general cargo ships. Building and maintaining seafarers' trust is essential, as it directly affects the efficiency of their onboard work performance, and furthermore can make it challenging to maintain the safety culture.
- **Tankers:** Tankers, given the sensitive nature of their cargo, have well-developed and structured safety measures and established procedures compared to other ship types. They, however, remain vulnerable to common safety issues. One significant issue, with high impact, for tanker ships is the matter of differential seafarers' transit travel rights (SI2). Ensuring equitable transit travel rights for seafarers is of utmost importance, particularly considering the nature of their cargo and the

international reach of their operations. This aspect becomes even more critical in the context of tanker ships, which have the shortest contract periods due to their high-intensity operations. Transportation of sensitive or hazardous cargo can be very demanding in terms of constant alertness and situational awareness, and if seafarers are required to stay onboard beyond their contract periods, they may experience mental exhaustion faster than other ship types. This is especially concerning because operations involving sensitive cargo are more susceptible to human errors. Consequently, addressing these transit travel rights is not only a matter of fairness but also a key factor in maintaining crew well-being and operational safety. Furthermore, stress and fatigue (SI8) emerged as the safety issue with the high impact on tanker ships, and this is particularly concerning, as these factors can significantly impact crew performance and safety, a critical consideration when dealing with sensitive cargo. Additionally, maintaining the collective experience of the crew on board is a vital requirement for many tanker owners and charterers; therefore, the decrease in collective years of experience (SI11) is a critical issue, emphasizing the necessity of retaining the experienced crew in the industry to ensure effective and safe operations.

As the study navigates the complexities of the maritime landscape in the wake of COVID-19, it becomes imperative to understand the trajectory of these emerging risks and potential safety issues that have been identified. Through the insights of the workshop experts, the study captured their perceived transience over short, medium, and long-term horizons. The goal of the next analysis is to additionally use the power of regression analysis to predict the evolution of these safety issues based on expert inputs.

Regression analysis insights of the evolution of emerging risks and safety issues over time

Regression analysis is a statistical tool that enables to determine the strength and character of the relationship between a dependent variable and one or more independent variables⁶⁷. In the context of this study, the regression analysis examined the relationship between the impact scores of different safety issues (dependent variables) and the passage of time, categorized into short, mid, and long-term frames (independent variables).

Before initiating the analysis, it is essential to ensure that the data is structured appropriately. Specifically, each safety issue, ranging from SI1 to SI18, had an assigned impact score for each of the three-time frames, derived from the averaged inputs of the 15 experts. The dataset was thoroughly examined, and it was confirmed that no missing values were present.

After data preparation, the evolution of safety risks was analysed through the establishment of a regression model. 18 linear regression analyses were conducted, using the impact scores of the safety issues as the dependent variables and the time frames (short, mid, and longer-term) as the independent variable. The coefficients derived from this analysis provided insights into the rate and direction of change for each safety issue over time. To understanding the key metrics, it is important to note that:

- *Beta (coefficient)* gives the direction and magnitude of change. A negative value implies a decrease in the impact score with the progression of time;
- *p-value* indicated the significance of the regression model. A p-value below 0.05 indicates a statistically significant relationship between the timeframe and the safety issue's impact score. The asterisk (*) next to the p-values in the table highlights the significant relationships; and
- *R-squared* represents the proportion of variance in the dependent variable that can be predicted from the independent variable. Higher values suggest that the model explains a larger portion of the variability.
- The *t-test* in this study regression analysis assesses if time significantly affects safety issues. It checks if observed changes are statistically valid or random. A high absolute t-value indicates strong evidence against the null hypothesis of no effect. For "Behaviour and attitude change (SI1)", a t-value of -3.150 and a p-value of .004 signify a notable negative trend over time.

⁶⁷ Hinton, P. R., McMurray, I., & Brownlow, C. (2014). SPSS explained. Routledge. London/UK. <https://doi.org/10.4324/9781315797298>

Each model's goodness of fit was evaluated using the *R-squared* value. Additionally, the assumptions of linear regression, including linearity, independence of errors, homogeneity, and normality of error distributions, were checked and found appropriate to validate the regression outcomes. Through these regression analyses, distinct patterns have emerged, as presented in Table 13. An interpretation of the results of regression analysis ensues.

Table 13: Results of the regression analysis of the evolution of emerging risks and safety issues

Dependent variable	Beta	t	p-value	R-squared
SI1 - Behaviour and attitude change	-.512	-3.150	.004*	.262
SI2 - Differential seafarers' transit travel rights	-.230	-1.249	.222	.053
SI3 - Unharmonized regulatory landscape	-.547	-3.454	.002*	.299
SI4 - Changing risk perception	-.144	-.770	.448	.021
SI5 - Delayed maintenance	-.200	-1.079	.290	.040
SI6 - Uncharted complex risk landscape	-.259	-1.417	.168	.067
SI7 - Cyber vulnerabilities	-.484	-2.929	.007*	.235
SI8 - Stress and fatigue	-.162	-.871	.391	.026
SI9 - Erosion of seafarers' trust	.013	.070	.944	.000
SI10 - Timely risk communication	-.250	-1.367	.183	.063
SI11 - Decrease in collective years of experience	-.135	-.718	.478	.018
SI12 - Maintenance of safety culture	-.542	-3.408	.002*	.293
SI13 - Restructured supply chain	-.386	-2.211	.035*	.149
SI14 - Impact on teamwork	-.281	-1.550	.132	.079
SI15 - Challenges in resilience testing	-.182	-.980	.335	.033
SI16 - Maintenance of skills and competency	-.315	-1.754	.090	.099
SI17 - Resource constraints	-.144	-.768	.449	.021
SI18 - Lost opportunity of knowledge transfer	-.515	-3.182	.004*	.266

*p-value \leq 0.05 suggests that the observed relationship is statistically significant

Safety issues with significant change

"Behaviour and attitude change (SI1)" has seen a notable decrease as time has progressed, with the regression model accounting for 26.2% of its variance. In simpler terms, as time goes by, this concern is diminishing, and the analysed data suggests a fair understanding (26.2%) of this change. The beta coefficient (-0.512) for this issue points to a moderate negative relationship over the studied time frames (i.e., short, mid and longer-term).

Similarly, "unharmonized regulatory landscape (SI3)" is also dropping as time progresses. Roughly 29.9% of this drop can be attributed to the time factor. This means nearly a third of this issue's decline is due to the changes happening over the set time periods.

"Cyber vulnerabilities (SI7)" and "maintenance of safety culture (SI12)" have also shown significant declines, with the regression models explaining 23.5% and 29.3% of their respective variances. In simpler terms, as time goes by, these two concerns are diminishing, and the analysed data suggests a decrease of 23.5% and 29.3%, respectively.

The impact of "Restructured supply chain (SI13)" is fading over time. The progression of time accounts for about 14.9% of this fading impact. In simpler terms, of all the factors that might be causing this issue to lessen, the time factor can explain about 15% of it.

Lastly, as with the other issues, the importance of "lost opportunity of knowledge transfer (SI18)" concern is also dropping over time. The timeframes analysed can explain about 26.6% of this decrease; i.e., more than a quarter of the reason this safety issue is declining is due to the progression of time. presents a discernible decline, explaining 26.6% of the variance.

Safety issues with no significant change

On the other hand, for safety issues like differential seafarers' transit travel rights (SI2), changing risk perception (SI4), delayed maintenance (SI5), and others up to resource constraints (SI17), their levels remain quite consistent over time. Their low R-square values, like 5% or 2%, mean that the time frame studied only explain a small part of the behaviour of these safety issues. In another words, the regression model used in this analysis may not capture all the factors influencing their trajectories. This suggests that, while time may have a slight influence, there might be external variables or inherent complexities at play, which have not been factored into the current regression analysis.

Concluding remarks

The insights presented are based on the expertise of 15 maritime professionals and shed light on various safety dynamics of the maritime sector. The decline in concerns such as “Behaviour and attitude change (SI1)”, “Unharmonized regulatory landscape (SI3)”, “Cyber vulnerabilities (SI7)”, “Maintenance of safety culture (SI12)”, “Restructured supply chain (SI13)”, and “Lost opportunity of knowledge transfer (SI18)” suggest that industry responses or strategic actions might be addressing these effectively. However, challenges like “Differential seafarers' transit travel rights (SI2)” and “Changing risk perception (SI4)” remain constant, indicating potential deep-rooted issues or elements not covered in the current models.

For a richer and more detailed understanding, it is recommended to conduct further research involving a larger pool of maritime experts. Engaging a wider pool of experts might provide deeper insights into the Safety issues like “Differential seafarers' transit travel rights (SI2)”, and “Changing risk perception (SI4),” leading to a comprehensive narrative of the evolving risks and safety issues in the maritime sector. It would also aid in eliciting a more detailed picture of the sector's evolving risks and safety issues, laying the groundwork for precise predictions and targeted safety interventions.

Moving forward into the subsequent chapters, attention will shift to explore the lessons learned and outlining measures for risk mitigation.

3. Fishing industry

3.1 Introduction

The fishing industry has long played a vital role in global economies, contributing to food security, poverty reduction, employment, and trade. With millions of people⁶⁸ globally dependent on this sector for their livelihoods, the fishing industry has been a cornerstone of coastal communities and a driver for sustainable development.

The EU holds a significant position in the global fishing arena, boasting a fleet of about 79,000 vessels⁶⁹ and contributing approximately 6%⁷⁰ to worldwide fisheries production. According to the Synopsis Report based on data provided by Member States⁷¹, around 130 thousand fishers are directly employed in the sector, generating an impressive annual revenue of over €6 billion. The EU's influence in the fishing sector is noteworthy, and notably, Spain, Denmark, France, and the Netherlands stand out as leading Member States in terms of volume.

However, the fishing industry, like many others, has not been immune to the unprecedented challenges brought about by the COVID-19 pandemic. The COVID-19 pandemic has, in fact, caused disruptions across diverse sectors, impacting public health and the global economy. Governments and industries have had to swiftly adapt to mitigate the virus's transmission while continuing essential operations. As the world grappled with the far-reaching implications of the health crisis, the fishing industry faced its unique set of circumstances, demanding a thorough evaluation of the emergent safety risks that have arisen and require immediate attention and systematic analysis.

According to data from EMCIP, while marine casualties and incidents in general decreased between 2019 and 2020 for cargo and passenger ships, fishing vessels exhibited an opposite trend during the same period, experiencing an increase in safety incidents⁷². Furthermore, the data revealed that the safety occurrence indicator⁷³ for fishing vessels was 51, marking a notable increase over the period from 2014 to 2021. These figures underscore the urgency of the study's focus on safety issues within the fishing industry that have emerged during the COVID-19 pandemic, with particular focus on commercial fishing vessels. By examining the dynamic interactions between fishing practices, workforce, supply chains, and public health considerations, the study aims to provide a comprehensive analysis of the safety issues faced by the fishing industry.

The objectives of this study are as follows:

- to gather insights on the impact of COVID-19 on EU fishing vessel operations and safety onboard fishing vessels;
- to identify immediate, short-term, and long-term safety issues that emerged due to the pandemic and the response of the EU fishing industry; then accordingly,
- to investigate the lessons learned from the pandemic within the fishing industry.

This report is the culmination of a research, data analysis, and expert insights, intended to offer valuable guidance to policymakers, industry stakeholders, and concerned parties in their efforts to safeguard the health and safety of fishing communities during these turbulent times.

⁶⁸ According to FAO, roughly 58.5 million individuals are engaged in primary fish production worldwide, with women accounting for about 21% of this workforce (source: The World Bank (2023). Blue Economy. <https://www.worldbank.org/en/topic/oceans-fisheries-and-coastal-economies>).

⁶⁹ According to data reported by Member States through the EU MAP (EU Fleet Register), there were 56,111 active vessels during that year, providing direct employment to 124,636 fishers (source: Scientific, Technical and Economic Committee for Fisheries (STECF) - The 2022 Annual Economic Report on the EU Fishing Fleet (STECF 22-06), Prelezo, R., Sabatella, E., Virtanen, J. and Guillen, J. editors, Publications Office of the European Union, Luxembourg, 2022, doi:10.2760/120462, JRC130578.)

⁷⁰ In 2020, the EU fishing industry's Gross Value Added (GVA) and gross profit, excluding subsidies and fishing rights, were estimated at EUR 3.3 billion and EUR 1.16 billion, respectively. GVA represented 55% of the revenue, while the gross profit margin was nearly 20%. The total net profit for the year was approximately EUR 0.4 billion, indicating that 7.2% of the revenue was retained as profit (source: *ibid.*)

⁷¹ European Commission: Synopsis Report of data provided by Member States according to article 118(1) of Council Regulation (EC) No. 1224/2009.

⁷² EMSA. (2022). Annual Overview of Marine Casualties and Incidents 2022. European Maritime Safety Agency (EMSA). Lisbon, Portugal.

⁷³ The ship occurrence indicator represents the number of marine casualties and incidents in one year per one thousand EU27 flag ships under the scope of Directive 2009/18/EC.

In the following sections of the report: Overview of the previous studies and surveys conducted by official entities on the impact of COVID-19 on the fishing sector is presented in Section 2. Section 3 presents the perspective of impact of COVID-19 on fishing from the point of view of fishers and fishing enterprise personnel. Section 4 discusses the emerging risks and the potential safety issues. Section 5 presents the stakeholder response in the fishing sector to tackle the impact of COVID-19, while Section 6 discusses the lessons learned for the fishing industry. Finally, Section 7 concludes the study report.

3.2 Overview of the previous studies on the impact of Covid-19 on fishing industry

The objective of Section 2 is to present an outline of prior research, gathered as part of the literature review for this study, commissioned by official entities to assess the effects of COVID-19 on the fishing industry. This overview will encompass a synopsis of key findings and pertinent bibliographic details from these studies, comprising publication date, conducting organization, and online document accessibility.

Title: [The state of world fisheries and aquaculture- towards blue transformation, 2022](#)⁷⁴

Overview: The report by the Food and Agriculture Organization (FAO) delves into the effects of the COVID-19 pandemic on global fisheries and aquaculture. It draws attention to disruptions in supply chains, the decline in production and employment, and the particular vulnerabilities faced by small-scale enterprises and marginalized groups. The report underscores the importance of resilience-building, adaptation, and robust social protection systems to shield the industry and its stakeholders from future crises.

Title: [Impacts of the COVID-19 pandemic on EU fisheries and aquaculture](#)⁷⁵

Overview: This research for the European Parliament's Committee on Fisheries provided an in-depth examination of the impacts of COVID-19 on the fisheries and aquaculture sectors of the EU in 2020. The research not only offers a broad view of the predominant effects across the EU but also presents specific case studies from eight member states⁷⁶. It concludes with policy recommendations aimed at bolstering the sector's resilience against future shocks and highlights the need to proactively address existing vulnerabilities.

Title: [The impact of COVID-19 on the EU-27 fishing fleet](#)⁷⁷

Overview: This report by the Joint Research Centre assesses the economic consequences of the COVID-19 pandemic on the EU-27 fishing fleet. With challenges like a dip in demand, interrupted supply chains, a decrease in fishing effort, and evolving consumer behaviours, the industry grappled with varied impacts. The report indicates that while the EU fleet largely remained profitable, the degree of impact was not uniform across countries, regions, or types of fisheries. It emphasizes that the small-scale coastal fleet bore a greater brunt due to its reliance on direct sales to eateries.

Title: [The 2022 annual economic report on the EU fishing fleet](#)⁷⁸

Overview: The Joint Research Centre's 2022 Annual Economic Report furnishes a meticulous assessment of the structure and financial performance of the EU's fishing fleet from 2008 to 2022. The report touches upon areas like fishing capacity, effort, employment, income, and costs, with a particular emphasis on the challenges brought about by the COVID-19 pandemic and its repercussions on the fleet's performance metrics.

⁷⁴ <https://www.fao.org/3/cc0461en/cc0461en.pdf>

⁷⁵ [https://www.europarl.europa.eu/RegData/etudes/STUD/2021/690880/IPOL_STU\(2021\)690880_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2021/690880/IPOL_STU(2021)690880_EN.pdf)

⁷⁶ Eight member states include: Bulgaria, Denmark, Italy, Portugal, Sweden, Greece, Spain, and France

⁷⁷ https://publications.jrc.ec.europa.eu/repository/bitstream/JRC122999/impact_covid_fisheries_d2_final4_online.pdf

⁷⁸ <https://publications.jrc.ec.europa.eu/repository/handle/JRC130578>

Title: [U.S. seafood industry and for-hire sector impacts from COVID-19: 2020 in perspective](#)⁷⁹

Overview: National Oceanic and Atmospheric Administration (NOAA) Fisheries' comprehensive report shines a light on the daunting challenges that the U.S. seafood industry grappled with during the COVID-19 pandemic. The document elaborates on substantial revenue declines across commercial fishing, aquaculture, and the recreational for-hire sectors. The findings underscore how an industry that typically bolsters the U.S. economy, generating substantial sales and employment, faced unprecedented hardships. The insights provided serve as a foundation for crafting recovery and resilience strategies.

Title: [Capturing the impacts of COVID-19 on the fisheries value chain of Southeast Asia](#)⁸⁰

Overview: The report by the Southeast Asian Fisheries Development Center (SEAFDEC), 2020, accentuates the profound implications of the COVID-19 pandemic on the fisheries and aquaculture sector in Southeast Asia. Drawing attention to the plight of small-scale fishers, the paper recommends embracing the ecosystem approach to fisheries management as a strategy to strike a balance between ecological and human welfare. It advances the case for equipping fishers with enhanced skills, introducing alternative income streams, and adopting novel marketing paradigms. Central to its conclusions is the advocacy for collective action involving governments, NGOs, the private sector, and fishing communities for a holistic recovery.

Title: [Impacts of COVID-19 on the Australian seafood industry: January-June 2020](#)⁸¹

Overview: The research by the Fisheries Research and Development Corporation delves into the varied effects of the COVID-19 pandemic on Australia's seafood sector. It chronicles experiences ranging from beneficial outcomes to severe setbacks. With exposure levels to disrupted supply chains and markets serving as determinants, some sectors flourished thanks to retail-centric models, while others, especially those anchored to exports and dine-in services, confronted adversities. The paper underlines the need for robust business continuity plans, enhanced data collection mechanisms, and the importance of adaptability in the face of lingering uncertainties.

Thematic analysis of the official reports

A thematic analysis of the seven official reports presented above has been performed to offer an understanding on the impacts of the COVID-19 pandemic on the fishing industry. The COVID-19 pandemic unveiled a series of challenges for the fishing industry, spotlighting several pivotal themes. **Supply Chain Disruptions (Theme 1)** became glaringly evident as transport interruptions and a diminished workforce impacted the availability of fish in markets and constrained resources for fishing operations. Parallel to this was the **Economic Impact (Theme 2)** experienced globally: the EU-27 fishing fleet saw stark economic downturns, the U.S. faced dwindling commercial fishing revenues, and the Australian seafood industry oscillated between growth and significant challenges. These economic strains were further intensified by changes in **Consumer Behaviour (Theme 3)**, catalysed by lockdowns and evolving health guidelines. Particularly hard-hit were the **Small-Scale Fisheries (Theme 4)**, essential pillars of local economies, which grappled with heightened vulnerabilities compared to their large-scale counterparts. In reaction to the unfolding challenges, **Government and Policy Responses (Theme 5)** were rolled out worldwide, leaning into promoting local outputs and crafting direct sales avenues. Concurrently, there was a global pivot towards **Adaptation and Resilience Strategies (Theme 6)**, with the Southeast Asian sector emphasizing ecosystem approaches and Australia advocating for continuity planning. Not to be overlooked, the **Employment Challenges (Theme 7)** took centre stage as many within the sector, from fishers to distributors, confronted job insecurities. Yet, amidst these adversities, the **Future Outlook and Industry Transformations (Theme 8)** remained forward-thinking, geared towards data-driven recovery pathways, embracing online seafood sales, and recognizing potential lasting shifts in consumer habits and global uncertainties. An overview of the thematic areas covered by official reports in the fisheries sector is presented in Table 14.

⁷⁹ <https://spo.nmfs.noaa.gov/sites/default/files/TMSPO221-v2.pdf>

⁸⁰ <https://repository.seafdec.org/handle/20.500.12066/6557>

⁸¹ <https://www.frdc.com.au/sites/default/files/inline-files/2016-128-Product-Impacts-COVID19-Report-01Mar2021.pdf>

Table 14: Thematic overview of official reports on COVID-19 in the fisheries sector

Theme	Thematic Area
1	Supply chain disruptions
2	Economic impact
3	Consumer behaviour
4	Small-scale fisheries
5	Government and policy responses
6	Adaptation and resilience strategies
7	Employment challenges

3.3 Identification of the baseline for fishing vessel safe operations

The baseline describes the standard practices and routines that were typical in the fishing industry prior to Covid-19 outbreak. This baseline serves as a reference point for assessing the extent of deviation caused by the pandemic, allowing for a comprehensive comparison between pre-COVID and pandemic-era operations to gauge the true impact on fishing vessel activities. The study gathered insights through interview and surveys from three main clusters of commercial fishing vessels including:

- Small-scale coastal fishing vessels: These are vessels with a length overall (LOA) of less than 12 meters and not using towed fishing gear. This category includes boats engaged in inshore fishing activities, using gears like nets, lines, and traps. These vessels often have a smaller number of crew and are limited to shorter trips closer to the coast.
- Vessels between 12-24 meters LOA: They are larger than the small-scale vessels but not as extensive or equipped as the large ocean-going vessels, and could use a variety of fishing methods.
- Vessels above 24 meters LOA: These are the larger, ocean-going vessels that can stay at sea for extended periods. They might be involved in deep-sea fishing, trawling, or other extensive operations, and they typically have larger crews and more substantial onboard facilities.

Table 15: Baseline indicators for safety of operations in the fisheries sector

#	Baseline indicator	Key parameters
1	Crew size and composition	<ul style="list-style-type: none"> ▪ Number of crew based on vessel size ▪ Ratio of experienced to novice fishers
2	Crew change	<ul style="list-style-type: none"> ▪ Frequency of crew rotations ▪ Procedures/protocols for embarkation and disembarking crew
3	Crew certification and basic training	<ul style="list-style-type: none"> ▪ Compliance with certification requirements for fishing operations ▪ Compliance with safety and emergency response training
4	Working hours and routines	<ul style="list-style-type: none"> ▪ Duration of fishing expeditions ▪ Shift patterns during continuous fishing ▪ Rest hours in compliance with the applicable regulations⁸²
5	Onboard facilities and living conditions	<ul style="list-style-type: none"> ▪ Quality of accommodation spaces ▪ Availability of crew amenities recreational facilities ▪ Access to hygiene facilities, fresh water, etc.
6	Health and safety measures	<ul style="list-style-type: none"> ▪ Availability of personal protection equipment ▪ Availability of crew training on handling safely the fishing equipment on board such as fishing gear ▪ Protocols for managing medical emergencies ▪ Compliance with the applicable regulations⁸³

⁸² Eg. IMO’s International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW-F), 1995, and ILO’s C188 - Work in Fishing Convention, 2007 (No. 188).

⁸³ Eg. IMO’s International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW-F), 1995, and ILO’s C188 - Work in Fishing Convention, 2007 (No. 188).

7	Maintenance of vessel and equipment	<ul style="list-style-type: none"> ▪ Meeting regular maintenance schedules for vessel ▪ Respecting the inspection routines for vessel equipment, in particular fishing gear ▪ Availability of contingency plans for critical equipment failure
8	Vessel inspections	<ul style="list-style-type: none"> ▪ The frequency of vessel safety inspections ▪ Compliance with fishing vessel regulations ▪ Compliance with regulations related to fishing quota and protected species ▪ Compliance with catch documentation and reporting requirement
9	Port operations and supplies	<ul style="list-style-type: none"> ▪ Efficiency of port logistics for fishing vessels ▪ Availability of fishing supplies and provisions ▪ Availability of waste disposal management and port reception facilities
10	Market and economic factors	<ul style="list-style-type: none"> ▪ Fluctuation of fish market prices ▪ Economic impact of fishing quotas ▪ Influence of international and regional trade agreements

Table 15 presents the baseline indicators related to safety of normal operations in fisheries. The identified key aspects of the baseline normal operations are discussed below.

Crew size and composition

Fishing vessel crew size is an essential aspect of fishing operations and can vary significantly depending on factors such as the type and size of the vessel, the fishing method used, the species targeted, and the duration of the fishing trip. Crew composition usually includes the captain or skipper, deckhands, engineers, and occasionally processing staff. The number of crew members is optimized to ensure safe and efficient fishing practices while considering the vessel's capacity and the workload required.

Crew change

Fishing vessels typically follow a predetermined rotation schedule for crew members. This ensures that crew members spend a specific period (often several weeks) on board before being relieved by a new crew. Crew changes usually occur when the fishing vessel docks at a designated port. This allows for the safe embarkation and disembarkation of crew members. Fishing vessel operators coordinate with relevant authorities, including port authorities and immigration agencies, to facilitate crew changes and ensure compliance with regulations. Before boarding the vessel, new crew members undergo health and safety checks, including medical screenings and safety briefings, to ensure they are fit for duty. Crew members must have the necessary visas, work permits, employment agreement, and documentation to enter and work in the EU countries. This is particularly important for international crew members. Crew members' contracts, working hours, rest periods, and compensation are typically outlined in employment agreements to ensure fair and safe working conditions.

Basic training and certification of crew

Crew members aboard fishing vessels undergo a variety of training activities to ensure their preparedness for the unique challenges presented by the fishing industry. Specialized training, tailored to their roles, encompasses fishing techniques, gear handling, navigation, engine operation, and fish handling. This focused training enhances the crew's capabilities and contributes to the overall efficiency of operations. Safety training takes on a critical role, encompassing protocols, emergency procedures, and the correct utilization of protective equipment. Regular drills bolster the crew's readiness to manage critical situations, ensuring the safety of all on board.

Continuous learning is very important to improve skills and maintain up-to-date knowledge of industry developments. This encompasses participation in workshops, seminars, and specialized courses covering fishing practices, safety protocols, navigation, and maintenance. Ongoing education keeps seafarers well-informed and adaptable to the ever-evolving maritime landscape. Practical experience is integral, with new crew members learning alongside experienced colleagues. Hands-on exposure to real-world scenarios fosters a deeper comprehension of operational challenges and effective solutions, thereby contributing to their overall competence.

Certification holds fundamental importance and is often obligatory, encompassing competencies such as competency certificates, seafarer's medical certificates, and proficiency in survival craft operation. This formal recognition ensures compliance with industry standards, equipping crew members to handle a variety of situations at sea.

Working hours and routines

On fishing vessels, working hours and routines are demanding and irregular due to the work's nature. Crew members face physically taxing conditions, but they work in shifts to ensure continuous fishing operations and allow for rest between duties. Fishing trips can vary in duration depending on catch success, and seasonal variations lead to peak periods of busier workloads and longer hours. Despite the challenges, regulations prioritize crew rest to prevent fatigue-related accidents and maintain job performance⁸⁴. Designated rest days on fishing vessels enable crew members to recover and conduct routine maintenance. Striking a balance between operational efficiency and crew well-being is regarded by fishing enterprises as crucial aspect for the sustainability and success of fishing operations.

Onboard facilities and living conditions

Onboard facilities and living conditions are crucial for the well-being and productivity of fishing vessel crew, especially during extended trips at sea. These facilities included berths for sleeping, communal areas for dining and relaxation, and sanitary amenities. It is important to note that onboard facilities and living conditions can vary widely depending on the type and size of the fishing vessel. Larger and more modern vessels tend to have better amenities and living conditions compared to smaller and older vessels. Crew members on fishing vessels often share living spaces, such as sleeping quarters, mess halls, and common areas. This close proximity encourages social interactions during off-duty hours, creating opportunities for crew bonding, and fostering teamwork, camaraderie, and mental well-being among crew members.

Health and safety measures

On fishing vessels, health and safety measures primarily focus on traditional maritime safety protocols related to, among others, safety equipment, crew training, personal protective equipment, emergency response protocols, navigation procedures, weather monitoring systems, crew work rest hours, fatigue management, and compliance with regulations. These measures aim to ensure a healthy and safe working environment for crew members and promote the overall safety of fishing operations. Additionally, for maintaining crew well-being and preventing health-related risks during fishing operations, measures such as access to medical facilities, sanitation standards, disease prevention protocols, and provisions for medical emergencies are followed on fishing vessels.

Maintenance of fishing vessels and their equipment

Efficient equipment and maintenance practices are vital for fishing vessels, ensuring safety, efficiency, and longevity. Gear like nets, lines, and winches, among others, requires regular inspection to prevent accidents during fishing operations. The engine and mechanical and electrical systems need routine checks and component replacements for optimal performance. Accurate navigation with GPS, radar, and echo-sounder and well-maintained communication systems ensure safety at sea. Regular inspections and maintenance of safety equipment, deck, hull, electrical systems, and fish processing equipment are crucial. Adhering to maritime regulations ensures compliance with safety and environmental standards. These practices enhance vessel productivity, crew well-being, and the long-term sustainability and profitability of fishing operations.

Fishing vessel inspections

Fishing vessels are subject to various national and international regulations and standards. Inspections verify compliance with these regulations, covering areas such as navigation, crew certification, gear, and operational practices. The overarching goal is to identify potential risks, deficiencies, and areas for improvement, ultimately contributing to safer and more sustainable fishing practices. Inspections include evaluating the vessel's environmental practices, such as waste management and compliance with regulations related to fishing quotas and protected species.

⁸⁴ STCW-F, MLC (If applicable depending on the country), and the related national regulations.

Various types of inspections and audits are conducted for fishing vessels, each with distinct purposes. Flag state inspections, performed by the vessel's country of registration, verify compliance with national regulations and international obligations. Third-Party Audits, undertaken by independent entities on behalf of fishing companies or industry groups, evaluate safety, environmental practices, and industry standards adherence. Catch Documentation Schemes audits concentrate on ensuring compliance with catch documentation and reporting requirements, aiming to prevent illegal, unreported, and unregulated (IUU) fishing.

Port operations and supply

Port operations and supply play a crucial role in fishing vessel operations upon returning to the port after a fishing trip. The process involves several key activities to ensure efficient and effective operations. Firstly, the fishing vessel offloads its catch, which is weighed and documented, with some ports conducting fish auctions, while others have pre-arranged contracts with buyers. Port workers assist with loading and unloading equipment. Quality control checks are performed to ensure the catch meets size, species, and overall quality standards. Compliance with customs procedures and fishing regulations is essential. The vessel also restocks essential supplies like fuel, food provisions, fishing gear, and spare parts for maintenance to prepare for the next fishing trip. Routine maintenance, repair, and cleaning are conducted in the port to keep the vessel in optimal condition and comply with safety standards. Crew changes may occur as some members disembark and others join the vessel. The captain and management team also use the time in port to plan the next fishing trip, including determining fishing grounds, routes, and potential market destinations.

Market and economic factors

The fishing industry's success is intrinsically tied to market stability and demand for seafood products, which, in turn, influences fish prices and overall profitability. However, when faced with economic challenges, some fishing companies may resort to cost-cutting measures that can have detrimental effects on safety and crew well-being. Reductions in budgets for safety equipment, crew training, and vessel maintenance can increase the risk of accidents at sea, jeopardizing the safety of crew members. Low incomes may force crew members to work longer hours and receive reduced rest periods, resulting in fatigue and potential health hazards. Moreover, financial constraints may hinder investments in crew welfare initiatives, impacting their quality of life onboard. To ensure the industry's sustainability and the well-being of its workforce, it is essential for stakeholders to prioritize safety measures and crew welfare, even during economically challenging times.

3.4 Perspectives on the impact of COVID-19 on EU fishing

The COVID-19 pandemic had far-reaching consequences across various sectors, and the fishing industry was no exception. This section provides an exploration of the perspectives on the impact of COVID-19 on EU fishing, drawing on interviews with experts from fishing, fishers and fishing enterprise personnel, and reports from official entities as presented in Section 3. In the thematic analysis of the interviews supported by other resources (reports, focus group discussion), six themes were identified as presented Table 16.

Table 16: Thematic overview of impact of COVID-19 on EU fisheries

Theme	Thematic Area
1	Human and operational impact
2	Economic shifts and market evolution
3	Regulations and governance
4	Technological advancements and fishing industry adaptations
5	Community engagement, collaboration and sustainability in the fishing industry
6	Future outlook and resilience in the fishing industry

- Theme 1- Human and operational impact:** The emotional repercussions of the COVID-19 pandemic resonated deeply within the fishing community. Particularly for large-scale fishing crews, the isolation felt immense. As articulated by a seasoned fisherman on a large-scale fishing vessel, *"being out at sea can be lonely, but with the pandemic restrictions, it felt like we were isolated from the entire world, not just the land."* This sentiment was exacerbated by health protocols that severely curtailed social interactions on fishing vessels. The enforcement of social distancing measures and restricted gatherings eroded the once lively crew

interaction, with smaller vessels bearing the brunt due to their confined spaces. The absence of traditional communal activities, like shared meals, further deepened the chasm of loneliness and detachment.

Operational challenges for fishing vessels emerged during the COVID-19 period. Maintenance delays became a familiar issue as lockdowns and restrictions hindered access to mechanics and spare parts. One fishing fleet technical manager pointed out, *"We were used to routine maintenance, but getting spare parts or even mechanics became challenging."* The ripple effect of these disruptions extended to supply chains, destabilizing the availability and cost of essentials such as fuel, food, and fishing gear. Such uncertainties threw a wrench in the planning and execution of extended fishing trips, as highlighted by the technical manager.

Safety took precedence during the pandemic. EU fishing vessels rigorously revamped their protocols to include measures like COVID-19 testing, quarantine, enhanced sanitation, and, social distancing. However, these safety measures posed unique challenges, particularly on small-scale fishing vessels, due to the restricted available space for crew movement onboard, as highlighted by participants from this fishing vessels category.

In the large-scale fishing industry, the challenges associated with crew management were stark. Travel restrictions and health concerns made crew changes a logistical nightmare, with many forced to remain at sea longer than usual. This issue was especially pronounced for migrant fish workers. Drawing a parallel with the shipping sector, similar issues like difficulties with crew changes and limited shore services were prevalent. Yet, the fishing community, often side-lined and marginalized, grappled with even greater adversity, as frequently highlighted in the literature. Their struggles, however, were not in vain. As the pandemic raged on, there was a growing acknowledgement of their significance. A poignant reflection from a fishing enterprise representative encapsulates this: *"Being recognized as essential didn't just mean priority in vaccines. It meant our struggles and our importance were finally being acknowledged."*

During the pandemic, port operations underwent a significant transformation. The onset of new safety and health measures, while critical, limited crew members' access to essential facilities, including healthcare. Additionally, the pandemic-induced delays due to prolonged authorities' visits, customs checks, fish catch verifications, and other formalities directly impacted the operations of fishing vessels. Both crew members and port workers had to quickly adapt to these changes to ensure uninterrupted operations. Concurrently, routine inspections of fishing vessels in EU faced disruptions. To navigate these challenges, innovative strategies, such as remote inspections and data monitoring, were adopted.

- **Theme 2- Economic shifts and market evolution in the fishing industry:** The COVID-19 pandemic ushered in a wave of transformative economic shifts in the fishing sector, reshaping the industry's market dynamics and operational paradigms. Owners of both small and large vessels confronted this new economic reality with varying challenges. The captain of a large vessel equipped with freezing capabilities recounted the duality of their position: *"Our vessel's size had its pros and cons, and although we had the luxury to store more and operate for extended durations, the diminishing market demand due to restaurant shutdowns hit us hard."* On the flip side, small-scale fishers, typically reliant on daily hauls and immediate sales, grappled with market accessibility issues. A local fisher described the situation: *"With local markets closed or having shorter hours, we rarely saw our usual customers."*

These market disruptions were not merely anecdotal. According to the FAO, there was a pronounced shift in seafood demand patterns globally, including the EU, primarily due to the widespread restaurant closures and restrictions on catering services. These disturbances led to volatile fish prices, further challenging an already distressed sector. Many fishing companies in the EU reported decreased revenues during this period. Some even faced the harsh reality of temporary shutdowns. Additionally, fishers ashore who could not join vessels faced concerns about job security, adding to the sector's uncertainties. This economic downturn not only threatened the stability of the industry but also indirectly impacted crew well-being, as reduced revenues could curtail investments in safety, crew welfare, and other essential amenities.

- **Theme 3- Regulations and governance:** During the pandemic, the governance structure of the fishing industry faced multifaceted challenges. The pandemic shone a light on certification recognition issues, which is crucial for hiring and cross-border operations on large-scale fishing fleets. A fishing enterprise representative described the situation by saying *"the lack of uniformity in the recognition of certifications across European countries posed challenges. Managing crews from various countries meant dealing with these certification disparities."*

Another concern that came to the forefront during the COVID-19 period was the IUU (Illegal, Unreported, and Unregulated) fishing. A fishing enterprise representative highlighted, *"the pandemic's challenges seemed to provide an avenue for exploitation...we do not have exact data, but the situation of less monitoring of fishing activities due to Covid-19 restrictions may lead to an increase in IUU incidents."*

The role of government support to the fishing sector across EU countries during this period was indispensable. Across Europe, governments-initiated measures, including financial assistance, loan offerings, and regulatory tweaks to alleviate the pressures on the fishing industry. Significantly, the European Commission stepped in, backing its Member States via the European Maritime & Fisheries Fund (EMFF) to mitigate the impact of COVID-19 on the fisheries sectors.

- **Theme 4- Technological advancements and fishing industry adaptations:** The COVID-19 pandemic triggered a notable shift in the fishing industry, marked by the integration of technological advancements and innovative adaptations. According to a fishing industry expert interview, there was an increased reliance on available technologies like blue boxes and satellite systems in most EU countries, more than before the onset of the pandemic. These technologies played a pivotal role in enhancing communication, tracking vessels, and ensuring regulatory compliance. Remote inspections carried out via satellite emerged as a ground-breaking solution, ensuring both the safety of operations and strict adherence to guidelines. As one fishing enterprise representative shared, *"through blue boxes and satellite systems, we could closely monitor catches and verify their alignment with electronic logs."*

In addition to these advancements, the EU fishing industry also leaned heavily on digital platforms to circumvent the challenges presented by the pandemic. As traditional supply chains were disrupted and markets shuttered, digital tools and applications became instrumental in facilitating direct sales to consumers. These platforms not only bridged the gap between producers and consumers but also ensured that safety measures, in line with pandemic-related regulations, were met. A notable reflection from a fishing enterprise representative was, *"During the COVID period, we shifted towards direct sales, allowing us to process and transform our catches into final products for consumers."*

Beyond these specific tools and platforms, the industry as a whole exhibited a broader technological adaptation. Electronic documentation processes and the ability to conduct remote inspections minimized the need for physical interactions. Moreover, the reliance on digital communication platforms became more pronounced, proving essential for maintaining operations, facilitating critical discussions, and ensuring compliance with regulatory bodies.

In light of the challenges of governance and the adaptations driven by the pandemic, one profound transformation stands out is the broader society's evolving perception of the fishing sector. As reflected by a fishing enterprise representative, *"The challenges of COVID-19 transformed how our industry is perceived, shifting us from being seen as problematic to being recognized as essential food producers."*

- **Theme 5- Community engagement, collaboration, and sustainability in the fishing industry:** The pandemic-induced challenges prompted the fishing industry to look beyond mere technological solutions, emphasizing the value of community engagement, collaboration, and sustainability. Cooperatives stood out as pillars of strength during this period. They not only organized and supported the fishing community but also played a pivotal role in distributing essential resources like personal protective equipment (PPE) and ensuring adherence to COVID-19 guidelines. One fishing enterprise representative acknowledged their contribution, noting how cooperatives, even smaller organizations, actively assisted by distributing essential items.

Sustainability emerged as another concern within the fishing industry. The interviews showcased an industry-wide acknowledgement of the imperative to adopt sustainable fishing practices. This ethos of conservation was aptly described by one representative, who emphasized the philosophy of catching just the *"interest"* to ensure the preservation of the foundational *"capital"* fish stock.

- **Theme 6- Future outlook and industry resilience in the fishing industry:** The COVID-19 pandemic prompted a re-evaluation within the fishing industry, pushing it to adapt to shifting market conditions and identify fresh opportunities. Supported by prior research, insights from the interviews highlight diverse recovery paths linked to vessel size and operational regions.

Specifically, smaller vessels operating predominantly in the Mediterranean, Baltic, and North Sea, which typically had fewer crew members, experienced a more streamlined return to operations post the initial health-related challenges of COVID-19. Their inherent adaptability, linked to fleet characteristics, allowed for a swift recommencement of fishing activities. On the other hand, larger fishing vessels, primarily navigating the Atlantic Ocean with a higher number of crew members, grappled with more pronounced challenges in resuming operations, mainly due to logistical and crew-related intricacies.

Apart from vessel dynamics, industry representatives emphasized the lasting imprint of the pandemic's lessons. While some practices might revert to how they were pre-pandemic, the experiences gathered—like the emphasis on direct selling, utilization of online platforms, and enhanced community relations—are poised to steer the industry's future. *"While some facets might edge back to the pre-COVID system, the pandemic's teachings are set to inform our onward journey in the fishing sector,"* shared a fishing enterprise representative. Moreover, echoing resilience and innovation, the industry showed a proactive bend by diversifying practices, such as transitioning to household direct sales and endorsing processed products. Technologies, including apps tailored for direct selling, were harnessed to ensure consumers' uninterrupted access to fresh fish amidst disruptions.

In conclusion, across the six themes, the study uncovered the EU fishing industry that is both dynamic and resilient, confronting the COVID-19 pandemic with a range of adaptive strategies. These strategies include the importance of governmental interventions, the surge in technological advancements, the pivot towards community-centric measures, the emphasis on sustainability, and the anticipation of a post-pandemic landscape. The industry's response to the pandemic highlights its ability to balance immediate challenges with forward-thinking approaches, whether in embracing digital tools or fostering community ties.

Following the analysis of the interviews with 15 participants from the fishing industry, including five fishers and ten fishing enterprise representatives, the focus in the next section is the emerging risks and safety concerns in the fishing industry due to COVID-19. The fishing sector's adaptability is evident, but forthcoming challenges suggest the need for innovative strategies, heightened preparedness, and proactive risk management.

3.5 Emerging risks and potential safety issues for EU fishing industry

This section delves into the multifaceted emerging risks and potential safety issues that have arisen due to the disruptions caused by COVID-19, illuminating their implications for the well-being of seafarers, operational safety, and the resilience of the fishing industry. The study approach entails an examination of various distinct emerging risks, including the effects of deviations from typical fishing operations, the interaction between health-related restrictions and safety concerns, and the complex balance between economic pressures and safety considerations.

Table 17: Emerging risks and potential safety issues for the fisheries industry

#	Emerging risk and potential safety issue
1	Crew well-being
2	Qualified labour shortages
3	Market fluctuations and financial strain
4	Delay in inspections and repairs

Crew well-being and its safety implications

The impact of health and safety challenges is inextricably linked to crew well-being, bearing immediate, short-term, and long-term consequences:

- **Immediate Impact:** The immediate risk of COVID-19 transmission fostered anxiety and stress among fishing vessel crew members, particularly, large scale vessels, compounded by concerns about potential outbreaks on other fishing vessels or in docking ports.
- **Short-Term Impact:** Isolation and limited social interactions at sea contributed to feelings of loneliness, exacerbated by restricted communication with family and friends. Unpredictable pandemic-related measures intensify uncertainty and disruptions in crew members' daily lives. Another short-term impact

is perceived to be accumulated fatigue, leading to reduced situational awareness, potentially compromising emergency response and safety protocol adherence.

- **Longer-Term Impact:** Prolonged stress due to persistent COVID-19 concerns may lead to lasting mental health issues for fishers, including depression, anxiety, and emotional exhaustion. The demanding nature of fishing work, combined with pandemic-related stressors, can escalate burnout among fishers in the future.

Qualified labour shortages and safety compromises

The effects of COVID-19 reflect significantly in the realm of labour availability in the fishing industry, posing a unique set of challenges to both operations and safety. Qualified labour shortages driven by COVID-19 are likely to impose safety risks upon fishing vessel operations, manifesting in immediate, short-term, and long-term consequences:

- **Immediate Impact:** Reduced crew size due to qualified labour shortages increased workload for remaining crew, affecting essential tasks and safety management.
- **Short-Term Impact:** Short-term labour deficits lead to fatigue and reduced alertness, potentially compromising emergency response and safety protocol adherence.
- **Longer-Term Impact:** Losing qualified labour in the fishing industry has a significant impact on safety. Practical experience gained alongside experienced colleagues is essential for developing competence and understanding operational challenges. The shortage disrupts this learning process, compromising safety standards and the industry's ability to address potential safety issues effectively.

Market fluctuations, financial strain, and safety trade-offs

COVID-19-induced market fluctuations and financial strain for fishing companies, affecting fishing operations, vessel safety and their crew members. These challenges encompass immediate, short-term, and long-term effects

- **Immediate Impact:** Immediate financial constraints may precipitate reduced safety investments and limited upgrades to safety equipment and technology, alongside a potential compromise in safety readiness due to market-driven decisions.
- **Short-Term Impact:** Short-term financial challenges can curtail crew training, maintenance, and repairs, potentially undermining safety awareness and impacting vessel seaworthiness. Simultaneously, market-driven uncertainties can influence safety-related expenses, vessel operations, and adherence to safety protocols.
- **Longer-Term Impact:** Prolonged financial strain may erode safety culture, impeding a steadfast commitment to safety measures and training. Accordingly, sustained market challenges may constrain safety-related budgets, reverberating through crew well-being, safety culture, and the capacity for investment in safety upgrades.

Delay in inspection and repair and their safety implications

Fishing vessel operations are heavily reliant on consistent maintenance and timely inspections to ensure the safety of crew members and vessel integrity. The disruptions caused by the COVID-19 pandemic have introduced significant challenges in this regard, leading to delays in inspection and repair activities, especially for large fishing vessels. These delays have resulted in a range of safety implications that span different timeframes.

- **Immediate Impact:** With technical issues potentially being overlooked due to these delays, there is a heightened risk of endangering both crew members of fishing vessels and the overall vessel safety. The inability to promptly address and rectify safety-critical problems poses an immediate threat to safe fishing operations.

- **Short-Term Impact:** Delay in maintenance can lead to a situation where multiple maintenance issues accumulate, affecting effectiveness of fishing activities and the vessel's overall safety. Financial strain emerges as another short-term consequence of delayed inspection and repair. Neglecting technical issues over an extended period during Covid-19 can lead to increased repair costs and operational disruptions. These financial implications contribute to a challenging environment for fishing companies, potentially limiting their resources to invest in safety-related measures and impacting the overall sustainability of their operations.
- **Longer-Term Impact:** The safety culture within fishing vessel operations may also be impacted over the long term. If safety concerns stemming from delays are not adequately addressed, it could have a negative influence on the priority placed on safety measures. A weakened safety culture may result in a lower commitment to maintaining and adhering to safety protocols, further exacerbating risks.

3.6 Stakeholder response to the impact of COVID-19 on EU fishing sectors

In the context of the COVID-19 pandemic, the EU fishing sector encountered notable disruptions. Such developments necessitated timely interventions from diverse stakeholders, ranging from global entities to distinct EU member states. This section endeavours to furnish an overview of these strategic responses, highlighting the concerted efforts employed to address the associated challenges. It should be noted that, while this summary seeks to capture salient measures and approaches, it is not an exhaustive account of all initiatives. Instead, it focuses on pivotal actions and alignments indicative of the overarching response strategies across different levels of governance.

3.6.1 United Nations' Agencies

- **Food and Agriculture Organization (FAO):** Recognizing the impending food security threats and the particular vulnerability of small-scale fisheries, the FAO promptly issued guidelines focused on sustainable fisheries and aquaculture. These guidelines emphasized supply chain resilience, staunch support for small-scale fishers⁸⁵, and the criticality of ensuring uninterrupted movement of food products in the face of global disruptions. Alongside these guidelines, there was a strong advocacy for digitalization in the sector, highlighting the importance of modernizing data collection, reporting, and monitoring systems to ensure operational continuity amidst the prevailing challenges
- **World Health Organization (WHO):** Acknowledging the unique challenges faced by the fishing industry, the WHO's guidance and protocols⁸⁶ proved beneficial. Though not exclusive to fishing vessels, these guidelines were essential for maintaining safety. The WHO underscored infection prevention measures, such as strict hygiene practices, the use of personal protective equipment (PPE), and physical distancing. Given the international nature of fishing operations, the risk-based travel guidelines⁸⁷ issued by the WHO were particularly pertinent. Their advice on on-board COVID-19 management, emphasizing treatment and isolation procedures, was also invaluable. Additionally, the introduction of standardized digital documentation for COVID-19 certification streamlined international operations for the industry. Through scientific briefs and advisories, the WHO ensured the fishing industry remained informed, emphasizing essential protective measures.
- **International Labour Organization (ILO):** The ILO swiftly reacted to the pressing challenges the maritime fishing sector faced in the wake of the COVID-19 pandemic. Not only did fishers confront prolonged onboard stays due to crew change hindrances, potential issues from certificate expiries, and limited access to essential supplies like PPE and medical care, but they also grappled with significant operational and welfare concerns. In its pivotal response, the ILO issued sector-specific guidance, amplified the advocacy for fishers' rights, and bolstered collaborative international efforts. Building on this, the ILO Resolution⁸⁸ extended welfare

⁸⁵ Food and Agriculture Organization (FAO). 2022. Selling the fish: Access to markets for small-scale fisheries during the COVID-19 pandemic. <https://www.fao.org/3/cb8102en/cb8102en.pdf>

⁸⁶ World Health Organization. (2021). An implementation guide for the management of COVID-19 on board cargo ships and fishing vessels: interim guidance, 23 December 2021. World Health Organization. <https://apps.who.int/iris/handle/10665/350941>

⁸⁷ World Health Organization. (2021). Technical considerations for implementing a risk-based approach to international travel in the context of COVID-19. https://apps.who.int/iris/bitstream/handle/10665/350941/WHO-2019-nCoV-Non-passenger_ships-2021.1-eng.pdf?sequence=1&isAllowed=y

⁸⁸ International Labour Organization (ILO). 2020. Resolution concerning maritime labour issues and the COVID-19 pandemic (adopted on 8 December 2020). https://www.ilo.org/wcmsp5/groups/public/---ed_norm/---relconf/documents/meetingdocument/wcms_760649.pdf

recommendations to fishers, emphasizing the need for a unified global response. The EU's pronounced support for this resolution, manifested in their active participation and subsequent statement, further solidified their dedication to protecting both seafarers and fishers.

3.6.2 The European Commission

In response to the COVID-19 pandemic's impact on the fishing sector, the European Commission implemented several measures to support the industry. Recognizing the immediate challenges, the sector faced due to lockdown measures, such as the closure of restaurants and food markets, travel restrictions, and alterations in consumer habits, the Commission initiated a multifaceted approach.

Spearheading the response, the Commission introduced sector-specific health and safety protocols. They also adjusted the European Maritime and Fisheries Fund (EMFF)⁸⁹ to offer financial aid to distressed fishers. Moreover, the European Market Observatory for Fisheries and Aquaculture Products (EUMOFA)⁹⁰ enhanced its role, becoming a pivotal hub for market intelligence during the crisis.

To alleviate the socio-economic impact further, the EU adopted several strategies. Notably, the Coronavirus Response Investment Initiative (CRII)⁹¹ was proposed, focusing on the rapid redirection of EU budget funds. This initiative allowed Member States to retain unspent European Structural and Investment Funds (ESIF)⁹², which includes the EMFF, effectively creating a financial cushion. The CRII+ package, introduced later, proposed amendments to the EMFF, allowing more support for the temporary cessation of fishing and aquaculture activities and greater flexibility in reallocating financial resources within operational programs.

In addition, the Commission's temporary framework for State aid was updated, permitting Member States to offer increased support to fishery and aquaculture companies. Alongside these sector-specific aids, the Commission highlighted other EMFF measures and structural funds that could benefit the sector. One significant initiative included a €1 billion budget guarantee to the European Investment Fund (EIF) to assist SMEs.

3.6.3 European Fisheries Control Agency

The European Fisheries Control Agency (EFCA) played a pivotal role in responding to the impact of COVID-19 in the fishing industry. The agency focused on various key areas, including the intensified enforcement of control measures to ensure compliance with regulations amid health and safety protocols, enhancing data collection and sharing for informed decision-making, fostering collaboration with EU member states to coordinate responses, advocating for fishers' rights and welfare, addressing crew change difficulties and access to essential supplies, and promoting adaptability within the industry⁹³. Some of the main measures included quarantine periods, PCR testing, and strict safety protocols for inspectors on EFCA-chartered ships to protect both fishers and inspectors. To adapt to the new challenges, EFCA shifted its focus to alternative instruments like data monitoring and analysis, used surveillance tools such as drones and satellite imagery, and conducted coordination activities virtually. EFCA also continued to support the European Union in fulfilling international control obligations, adapting control plans as necessary and analysing risks associated with reduced monitoring and control levels. Meetings and training were maintained with stakeholders, and at the corporate level, processes were adapted to teleworking measures, emphasizing digitalization in alignment with EU objectives.

3.6.4 EU Member States

Across the European Union, member states exhibited swift and comprehensive reactions to safeguard their fisheries and aquaculture sectors amidst the COVID-19 pandemic. Countries such as the Netherlands took a pioneering step by designating fishers as essential personnel along with seafarers. This significant classification ensured that they were among the first to receive vaccinations. This proactive approach not only provided them with health protection but also facilitated the continuity of vital fishing operations.

⁸⁹ European Council. 2020. European Maritime and Fisheries Fund post 2020. <https://www.consilium.europa.eu/en/policies/maritime-fisheries-fund/>

⁹⁰ European Market Observatory for Fisheries and Aquaculture Products (EUMOFA) <https://www.eumofa.eu/>

⁹¹ European Commission. 2020. Cohesion policy action against coronavirus. https://ec.europa.eu/regional_policy/funding/coronavirus-response_en

⁹² European Commission. 2021. EU Cohesion Policy: European Structural and Investment Funds supported SMEs, employment of millions of people and clean energy production. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_389

⁹³ European Fisheries Control Agency (EFCA). (2023). Anti-Covid Measures. <https://www.efca.europa.eu/en/node/398>

Italy, recognizing the urgency of the situation, introduced initiatives like the “Relief Decree” and “Liquidity Decree”. These measures provided financial assistance for specific categories within the fisheries sector, ensuring stability during difficult times. Parallely, in Sweden, a similar strategy was adopted. Fishers adversely impacted by the pandemic were granted the option to suspend their operations temporarily, receiving compensation to cover their fixed costs. This support was structured to span across 11 sub-periods in 2020 and was aimed at fishers who met certain criteria based on their activity in previous years.

Market disruptions were another challenge that EU member states had to navigate. While the Swedish fisheries sector encountered a slump in demand, especially in restaurants for certain products like the Norway lobster, they adapted. Strategies were put in place to distribute fishing efforts over time, ensuring that the market remained stable.

Greece's fishing sector also displayed resilience. After facing an initial setback at the pandemic's onset, the sector managed to recalibrate by increasing production levels, subsequently leading to a dip in export prices. This approach was fruitful, as Greece later observed an uptick in the exports of seabass and seabream during the latter half of the year.

Mobility restrictions were yet another hurdle, particularly impacting direct sales in all EU countries. This limitation, however, became a catalyst for promoting local seafood consumption. Such an approach not only helped to ensure continuous demand but also aimed to reduce the over-reliance on international seafood supply chains that faced potential disruptions.

From regulatory adaptation and relaxation, to tax advantages, wage subsidies, and loan guarantees, the measures implemented by EU member states to assist the fishing sector were vast and varied, and helped alleviate the hard impact of COVID-19 on the fishing sector to some extent.

In conclusion, the combined actions of international organizations, the European Commission, and EU Member States demonstrated a thoughtful and adaptable approach to the challenges presented by the COVID-19 pandemic in the EU fisheries sectors. Such strategic interventions, though varied, shared a common goal of offering support and resilience.

Moving into the next section, the discussion will explore the lessons learned from Covid-19, emphasizing how they might inform future strategies and preparedness of the fishing sector in the EU in similar scenarios, with a particular focus on safety of fishing vessels.

3.7 Lessons learned for fishing industry

In light of the challenging landscape presented by the COVID-19 pandemic, several lessons have emerged across different facets of the fishing industry. The following insights, among others, shed light on the invaluable experiences and transformative realizations garnered from both the shipboard and fishing enterprise perspectives. These lessons offer a glimpse into the industry's resilience, adaptability, and commitment to safety and sustainability. Each lesson, discussed below, contributes to a comprehensive understanding of the evolving dynamics within the fishing sector and paves the way for informed decision-making and future preparedness.

3.7.1 Lessons learned from the shipboard side

Importance of health and safety

Amid the COVID-19 pandemic, a profound understanding emerged regarding the paramount significance of health and safety protocols aboard fishing vessels. Crew members gleaned valuable insights into the critical need to diligently observe stringent hygiene practices, maintain social distancing, and properly utilize personal protective equipment (PPE). This served as a crucial safeguard to uphold their health and overall well-being.

Crisis preparedness

The pandemic underscored the indispensable requirement for robust and comprehensive crisis preparedness plans on fishing vessels. This period of adversity illuminated the undeniable value of having contingency strategies in place to swiftly address emergent situations, including onboard outbreaks or disruptions in supply chains. By doing so, fishing crews stand poised for a rapid and effective response to unforeseen challenges.

Mental well-being awareness

A poignant realization dawned upon crew members regarding the profound impact of prolonged isolation and the prevailing uncertainty on their mental well-being. This pivotal lesson underscores the imperative of establishing an intricate support framework, fostering open communication channels, and providing readily accessible mental health resources. By prioritizing crew resilience and psychological well-being, fishing operations can cultivate an environment conducive to sustained productivity.

Adaptability and flexibility

Navigating the uncharted waters of the COVID-19 era compelled fishing vessel crews to swiftly embrace evolving circumstances. The indelible lesson etched in these experiences underscores the pivotal significance of adaptability and flexibility. Equipped with these attributes, fishing vessel crews can skilfully overcome unforeseen challenges, ensuring the continued safety and efficacy of their operations.

3.7.2 Lessons learned from the fishing enterprise side

Supply chain resilience

The pandemic clearly highlighted the vulnerabilities inherent in the fishing industry's supply chains. This salient observation underscores the necessity of a strategic approach that includes diversifying suppliers, upholding a judicious reserve of critical provisions, and exploring alternative sourcing channels. By diligently reinforcing their supply chains, fishing enterprises can adeptly diminish the adverse effects of unexpected disruptions.

Financial planning and sustainability

The pandemic highlighted the essentiality of prudent financial planning and sustainability within the fishing industry. It underscored the need for a robust financial foundation and the judicious implementation of cost-effective safety measures to ensure the industry's long-term viability. Moreover, the COVID-19 crisis amplified the significance of sustainable fishing practices, not just for protecting marine ecosystems and enhancing the appeal of seafood products, but also for the safety and well-being of the crew onboard fishing vessels. By integrating sound financial reserves with sustainable practices, fishing companies can both secure their future in uncertain times and expand their business opportunities.

Investment in safety

The pandemic stands as a resounding affirmation of the paramount importance of safety investments within fishing enterprises. This pivotal lesson underscores the unwavering imperative of prioritizing safety at the highest echelon. Companies are duty-bound to allocate dedicated resources for crew training, the acquisition of state-of-the-art safety equipment, and rigorous maintenance procedures. In undertaking these measures, fishing enterprises can robustly protect their crew members and valuable assets from potential risks.

Collaboration and communication

The profound disruptions of the pandemic emphasized the pivotal role of collaboration and transparent communication within the fishing industry's ecosystem. This enduring lesson underscores the transformative potential of harmonious engagement among fishing companies, industry stakeholders, and regulatory bodies. By fostering an environment of open discourse and unwavering transparency, challenges can be collectively addressed, facilitating the seamless implementation of safety measures and regulatory compliance.

Table 18: Overview of lessons learned from COVID-19 for the fishing industry

Lessons learned on shipboard side	Lessons learned on fishing enterprise side
Importance of health and safety	Supply chain resilience
Crisis preparedness	Financial planning and sustainability
Mental well-being awareness	Investment in safety
Adaptability and flexibility	Collaboration and immunization

3.8 Conclusion

The COVID-19 pandemic, with its unexpected onslaught and relentless challenges, revealed both vulnerabilities and strengths within the EU's fishing industry. From on-the-deck shipboard operations to broad-scale enterprise logistics, the sector was tested in multifarious ways, underscoring the interconnectedness of global supply chains, the dependency on international markets, and the imperative for the well-being and safety of the workforce.

This chapter of the study illuminated a set of emerging risks and potential safety issues, within the fishing industry, that surfaced during this challenging period of COVID-19, including:

Crew well-being and safety implications

The pandemic's challenges have affected crew mental health, with the immediate fear of COVID-19 transmission leading to heightened stress, while isolation measures exacerbate feelings of loneliness and fatigue, paving the way for potential long-term mental health conditions like depression.

Qualified labour shortages and safety compromises

The industry has witnessed a considerable reduction in qualified crew members during the pandemic. These shortages may further contribute to a tangible decline in emergency preparedness and, in the long run, could threaten the safety standards and protocols upheld by seasoned professionals.

Market fluctuations, financial strain, and safety trade-offs

COVID-19 has induced significant financial strain on the fishing industry, influencing decisions that may result in diminished safety investments. As companies grapple with these financial challenges, there is potential for cutbacks in crucial areas like crew training and vessel maintenance, and over time, these financial stresses might erode the industry's commitment to a strong safety culture.

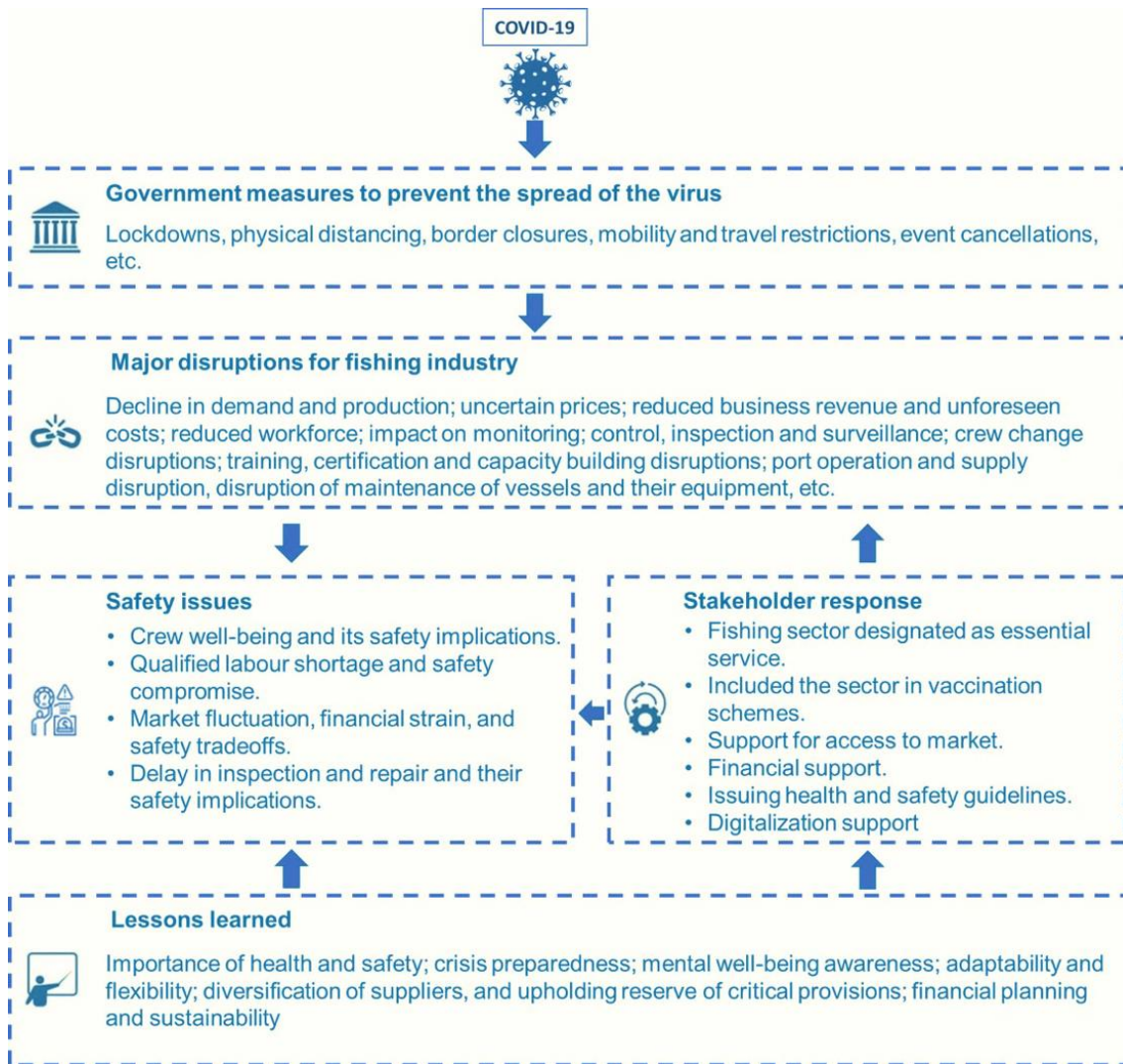
Delay in inspection and repair and the safety compromises

The industry has faced setbacks in regular inspection and repair schedules due to the pandemic's disruptions. These delays can introduce immediate risks by allowing technical issues to go unchecked, and as maintenance challenges accumulate, they can jeopardize both the safety and efficiency of fishing operations.

International organizations, like the World Health Organization and International Labour Organization, alongside the European Commission and EU Member States, showcased commendable agility and adaptability in their responses. From immediate health and safety protocols to long-term financial support, their actions epitomized the kind of collective global effort required in the face of such an unprecedented crisis. Their combined strategies offered not just immediate relief, but also illuminated pathways for future resilience in the industry.

Emerging from this crucible of adversity, the fishing sector garnered invaluable lessons. The emphasis on health and safety protocols, the acute need for crisis preparedness, a renewed focus on mental well-being, and the pivotal significance of adaptability stood out as guiding beacons for shipboard operations. Simultaneously, the broader fishing enterprise sector recognized the importance of supply chain resilience, the essence of sustainable and prudent financial planning, the unwavering commitment to safety, and the transformative power of collaboration and open communication. A framework summarizing the fishing industry's experience of COVID-19 is presented in Figure 20.

Figure 20: A framework summarizing the fishing industry’s experience of COVID-19⁹⁴



⁹⁴ Adapted from: <https://www.fao.org/3/cc0461en/online/sofia/2022/covid-crisis-fisheries-aquaculture.html>

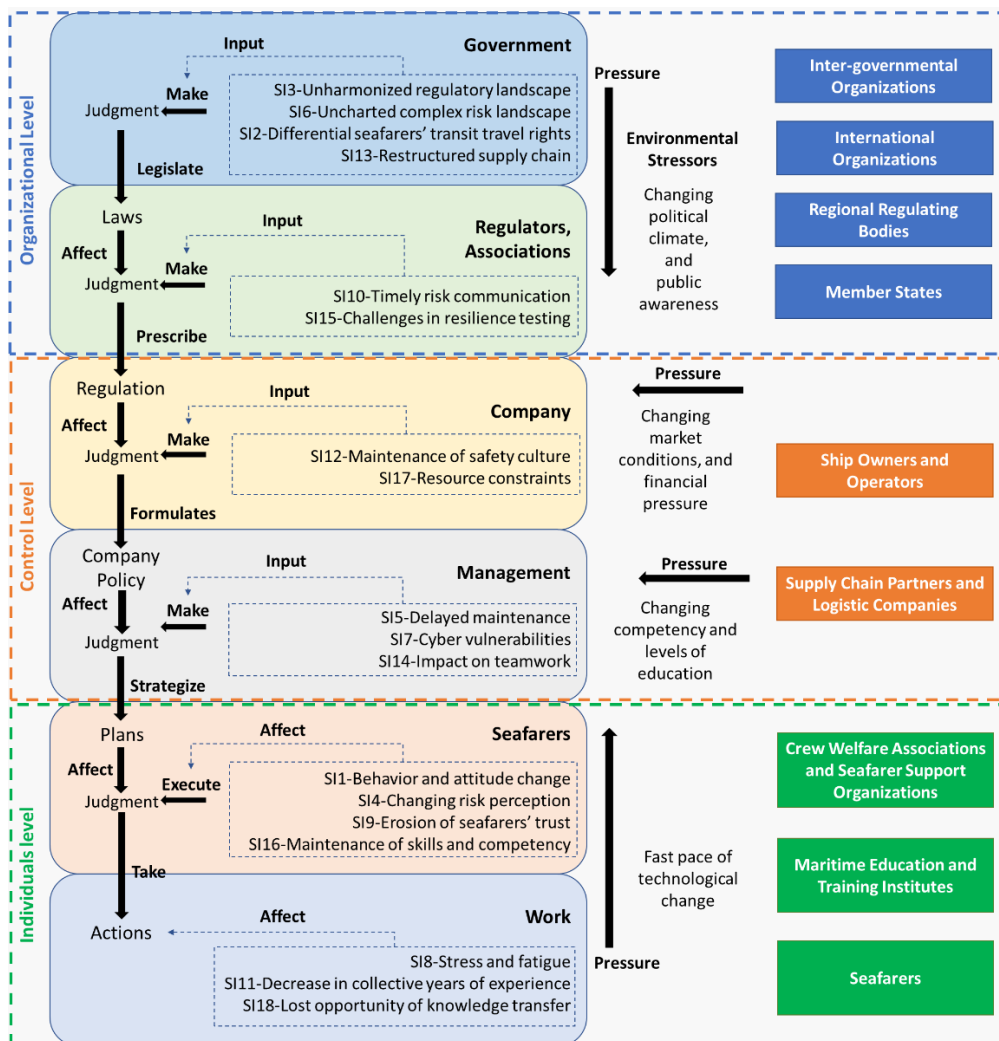
4. Lessons learned and mitigation measures

The maritime sector has undergone considerable stress and adaptation during the COVID-19 pandemic. All stakeholders in the maritime industry responded to the challenges posed by COVID-19. As the sector encountered diverse experiences and challenges, several lessons became apparent, shaping the approach to navigating future systemic challenges. This chapter begins by introducing the responses of maritime stakeholders to the challenges brought about by COVID-19. The chapter then, drawing on the findings of the study, delves into these lessons, offering insights into both their origins and their implications.

4.1 Stakeholder response to COVID-19

This subsection presents an overview of the measures taken by different stakeholders, including international organizations, European Commission, European Maritime Safety Agency, EU Member States, maritime training institutions, shipping companies, etc. to tackle the emerging risks to shipping from COVID-19. Figure 21 presents the main groups of maritime stakeholders at the organizational level, control level and individuals' level with respect to the Rasmussen's risk management framework.

Figure 21: Rasmussen's risk management framework and maritime stakeholders



4.1.1 United Nations and Specialized Agencies

The COVID-19 pandemic posed unprecedented challenges to the maritime industry, prompting swift and strategic interventions from the United Nations and its specialized agencies to safeguard maritime operations and ensure

the welfare of seafarers. These collaborative efforts as testimony to the collective strength and resilience of these agencies.

- **United Nations General Assembly (UNGA):** In December 2020, the UNGA passed a landmark resolution, underscoring the indispensable role of seafarers by designating them as key workers⁹⁵. Recognizing the myriad challenges seafarers faced amidst the pandemic, the resolution emphasized the need for collaborative strategies, uniting both governmental and private sectors, to facilitate essential activities such as crew changes, repatriation, and access to medical care.
- **International Maritime Organization (IMO):** A cornerstone of maritime regulations, IMO strongly advocated the rights and well-being of seafarers. IMO ardently called for their recognition as essential workers and advocated for streamlined crew changes, health protocols, and their prioritization in vaccination programs. The establishment of the Seafarer Crisis Action Team (SCAT) exemplified the IMO's unwavering commitment to offering tangible support to seafarers in distress⁹⁶. By endorsing the industry-driven Neptune Declaration⁹⁷, the IMO accentuated its dedication to mitigating challenges related to seafarers' welfare. Furthermore, in response to the use of remote surveys during the COVID-19 pandemic, guidance on assessment and application of remote statutory surveys and inspections and guidance on performance of ISM/ISPS audits and inspections is being developed at IMO⁹⁸. This takes into consideration, a submission made to the IMO Subcommittee on Implementation of IMO Instruments by the EU Member States and European Commission in collaboration with IACS proposing principles on remote surveys, among other things⁹⁹.
- **International Labour Organization (ILO):** Advocating for the rights and well-being¹⁰⁰ of seafarers, the ILO provided crucial guidance¹⁰¹ to governments, shipowners, and the seafarers themselves, ensuring adherence to the MLC, 2006 labour standards amidst the pandemic. Their collaborative efforts with other UN agencies heightened their impact, addressing vital concerns such as personal protective equipment, onboard medical care, and the unfortunate instances of seafarer abandonment due to COVID-19. The ILO/IMO database was adapted to encapsulate the pandemic-related cases of seafarer abandonment, further emphasizing their holistic approach.
- **World Health Organization (WHO):** While primarily health-centric, the WHO's contributions to the maritime sector were instrumental. They provided rigorous health protocols which became the cornerstone of numerous countries' maritime health responses. These protocols¹⁰² encompassed health and hygiene measures onboard vessels, the execution of health screenings, and the management of suspected COVID-19 cases.
- **United Nations Conference on Trade and Development (UNCTAD):** Turning their gaze to the economic implications of the pandemic on the maritime realm, UNCTAD illuminated disruptions in global supply chains and trade flows. Emphasizing sustainability and resilience, they championed coordinated international efforts to mitigate the adverse effects on maritime trade¹⁰³.

4.1.2 International organizations

As the COVID-19 pandemic swept across the globe, a multitude of international organizations took decisive action to address the challenges posed to the maritime sector. Their interventions, guidance, and resources played a crucial role in ensuring safety, well-being, and operational continuity in the maritime industry during COVID-19. The following list highlights some of these organizations, but it is by no means exhaustive.

⁹⁵ UN. 2020. General Assembly Adopts Three Resolutions

⁹⁶ IMO. 2020. Coronavirus disease (COVID-19) Pandemic.

⁹⁷ Initiated in May 2021, the Neptune Declaration provides data on crew change issues using Neptune Indicator. It builds on aggregated data from 10 ship managers: Anglo- Eastern, Bernhard Schulte, Columbia Shipmanagement, Fleet Management (FLEET), OSM, Synergy Marine, Thome, V.Group, Wallem, and Wilhelmsen Ship Management, which collectively have about 100,000 seafarers.

⁹⁸ IMO. 2023. Development of guidance on assessments and applications of remote surveys, ISM Code Audits and ISPS Code verifications. Report of the Correspondence Group. I119/10.

⁹⁹ Austria, et al. 2022. Development of guidance on assessments and applications of remote surveys, ISM Code Audits and ISPS Code verifications. I118/12/1. London: IMO.

¹⁰⁰ ILO. 2020. COVID-19 and maritime shipping & fishing.

¹⁰¹ ILO. 2020. Resolution concerning maritime labour issues and the COVID-19 pandemic (adopted on 8 December 2020).

¹⁰² WHO. 2021. An implementation guide for the management of COVID-19 on board cargo ships and fishing vessels.

¹⁰³ UNCTAD. 2021. COVID-19 and maritime transport: Impact and responses.

- **International Chamber of Shipping (ICS):** The ICS concentrated its efforts on the health and safety of seafarers¹⁰⁴. Offering ship operators tangible guidance on maintaining the well-being of crew members, their roadmap for seafarer vaccination was pivotal in keeping essential maritime operations functional. Their comprehensive resources address a spectrum of concerns from vaccination logistics to mental health.
- **International Transport Workers Federation (ITF):** The ITF's unwavering focus has been on the well-being and rights of seafarers. By consistently updating transport workers, especially seafarers, on pandemic-related developments, the ITF spotlighted and advocated for improved global seafarer conditions¹⁰⁵.
- **Baltic and International Maritime Council (BIMCO):** Acting as a beacon for the shipping industry, BIMCO provided invaluable guidance and resources, facilitating the sector's navigation through the pandemic's complexities¹⁰⁶. Their insights and information on adapting to operational changes and maintaining safety have been indispensable.
- **International Association of Classification Societies (IACS):** With a firm commitment to maritime operational integrity and safety, IACS extended its expertise to address the technical and regulatory challenges posed by the pandemic. Their guidance ensured the industry maintained high safety standards and compliance in an ever-evolving scenario. In particular, during the COVID-19 pandemic, IACS Members have ensured the continuation of survey activities¹⁰⁷ by implementing proactive risk assessment and management strategies to prioritize the safety of all parties involved¹⁰⁸.
- **International Association of Independent Tanker Owners (INTERTANKO):** Focusing especially on tanker operations, INTERTANKO's proactive approach brought forth resources ranging from outbreak management plans¹⁰⁹ to vessel inspection guidelines during the pandemic, all the while prioritizing crew well-being.
- **International Seafarers' Welfare and Assistance Network (ISWAN):** In the tumultuous times caused by COVID-19, ISWAN emerged as a stalwart supporter of seafarers' mental well-being¹¹⁰. Their resources and tools, designed to address the mental challenges posed by the pandemic's constraints, have been instrumental in promoting seafarers' resilience.

4.1.3 The European Commission

In the face of the COVID-19 pandemic, the European Commission acted swiftly to address the maritime sector's challenges. Recognizing the pivotal role of seafarers in European and global supply chains, the Commission urged member states to designate them as essential workers. This was crucial for facilitating crew changes, ensuring the continuity of the maritime supply chain, and reducing disruptions from travel restrictions.

To further safeguard seafarers' rights, the Commission issued guidelines emphasizing access to medical care, fair treatment, and smooth repatriation. The Commission also proposed "green lanes" or "fast lanes" to mitigate travel constraints, facilitating the seamless movement of maritime personnel across international borders.

The Commission's robust support for ILO Resolution, ratified on 8 December 2020, highlights the EU's particular commitment to maritime labour issues during the pandemic. This resolution spotlighted the plight of about 400,000 seafarers stranded offshore, rallying international entities to address the associated health and safety risks. Prominent maritime organizations, including the IMO and ICS, championed this initiative. The resolution emphasized seafarers' designation as "key workers," guaranteeing their access to medical facilities, irrespective of nationality, and advocated for expedited repatriation in emergencies.

Moreover, the ILO Resolution extended its recommendations to fishers, pushing for similar welfare measures. Referencing the UN Guiding Principles on Business and Human Rights, it reinforced the drive for a coordinated

¹⁰⁴ ICS. 2021. Coronavirus (COVID-19): Roadmap for Vaccination of International Seafarers, First Edition.

¹⁰⁵ ITF. 2021. Coronavirus (COVID-19) Vaccination for Seafarers and Shipping Companies: A Practical Guide.

¹⁰⁶ BIMCO. 2023. Ships Ports and Voyage Planning: Crew Support.

¹⁰⁷ Lloyd's Register. 2021. The evolving world of inspection technology.

¹⁰⁸ IACS. 2021. IACS Open Letter to the Industry.

¹⁰⁹ INTERTANKO. 2022. Outbreak Management Plan: Covid-19.

¹¹⁰ ISWAN. n.d. Coronavirus (COVID-19).

global approach. The EU's active involvement in the resolution's adoption, coupled with delivery of a statement, underscores the strong commitment to safeguarding the rights of seafarers and fishers.

At the pandemic's onset, the Commission introduced legislative changes in the light of lockdowns. Aimed at supporting the maritime industry, these adjustments catered to port infrastructure charges and certification delays. This proved essential in sustaining sectors like ferries during the COVID-19 period.

4.1.4 The European Maritime Safety Agency

Amidst the COVID-19 pandemic, EMSA emerged as a critical pillar in issuing guidance to EU Member States, acting as a beacon of maritime safety and best practices. The agency, in coordination with the European Centre for Disease Prevention and Control (ECDC), issued circulars detailing recommendations on preventive measures against the spread of COVID-19 aboard ships¹¹¹. This exhaustive guidance encompassed health protocols, robust risk assessments, and adept crew management procedures, providing a blueprint for navigating the complexities introduced by the pandemic. EMSA has also actively tracked the COVID-19 impact on shipping traffic since July 2020, releasing a series of analysis reports¹¹², aiming to evaluate the influence of the pandemic on shipping, with a specific focus on ship calls at EU ports, activities of ships flagged by EU Member States globally, and shipping routes from Europe to China and the US.

Acting as a platform¹¹³ for information exchange, EMSA played a pivotal role in ensuring EU member states remained well-informed and aligned in their response strategies. This collaborative approach was bolstered by EMSA's commitment to providing technical assistance, ensuring that shipping operations remained not only functional but also safe in the face of COVID-19 challenges.

Furthermore, EMSA also adapted its training programs to the virtual realm, ensuring that maritime professionals received uninterrupted training during times when physical sessions were unfeasible. They also accelerated the development and deployment of remote ship inspections to ensure the adherence to safety standards, even when on-site visits were limited.

Through these efforts and more, EMSA showcased its commitment and adaptability, ensuring the maritime sector remained resilient, safe, and informed during the unprecedented challenges of the COVID-19 pandemic.

4.1.5 EU Member States

In response to the myriad challenges posed by the COVID-19 pandemic, various EU Member States demonstrated adaptability and resilience in their maritime sectors. Countries such as the Netherlands, Spain, and Italy, proactively established designated ports for the safe execution of crew changes. Termed as "green lanes" or "fast lanes," these provisions were instrumental in allowing seafarers to embark and disembark while strictly adhering to health protocols, ensuring both their safety and the continuation of essential maritime operations.

Recognizing the impediments caused by the pandemic in areas of training and certification, a commendable move by many Member States was the extension of the validity of maritime certificates and licenses. This flexibility mitigated the challenges stemming from training disruptions and certification delays, ensuring that seafarers remained compliant and could continue their roles without administrative hindrances.

Furthermore, the psychological toll of the pandemic on seafarers, who often found themselves isolated or stranded due to global travel restrictions, was a grave concern. Addressing this, member states ramped up their efforts in prioritizing seafarers' mental health. Governments introduced initiatives providing seafarers with access to counselling services and number of mental health resources. Such measures underscored the recognition of the importance of holistic well-being, ensuring that the maritime workforce remained both physically and mentally robust amidst the tumultuous pandemic backdrop.

¹¹¹ EMSA. 2020. COVID-19: EU Guidance for Cruise Ship Operations.

¹¹² EMSA. 2020. COVID-19 Impact on Shipping.

¹¹³ EMSA. 2020. COVID-19 Measures.

It is also worth noting that several EU Member States collaborated and shared best practices, creating a unified front and coherent strategies in navigating the challenges of the maritime domain during these unprecedented times.

4.1.6 Port authorities, shipping companies and shipowners

During the onslaught of the COVID-19 pandemic, port authorities across the EU, in tandem with shipping companies and shipowners, orchestrated a coordinated response to navigate the unprecedented maritime challenges.

European port authorities, taking cognizance of the looming health risks, swiftly instated health screening measures for incoming crew members. This involved meticulous temperature checks and comprehensive health questionnaires designed to swiftly detect and manage potential COVID-19 cases. Recognizing the necessity of quarantine in this era, specific zones within port precincts were demarcated to facilitate seafarers' safe isolation either before boarding or post disembarkation. Moreover, forging synergies with shipping companies and local health bodies, ports devised robust procedures for the adept handling of suspected COVID-19 cases and ensuring timely medical intervention when warranted. This multi-faceted approach was exemplified in measures adopted by notable ports like Rotterdam.

Parallely, shipping companies, in their bid to sustain operations while safeguarding seafarers, instituted stringent health and hygiene standards onboard. Regular vessel disinfection became the norm, coupled with the enforcement of social distancing guidelines and the mandatory use of personal protective equipment (PPE) by crew members. Innovatively, they integrated telemedicine services, ensuring that seafarers, even in the midst of vast oceans, were not bereft of essential medical consultations. Augmenting these health measures, shipping companies worked in close collaboration with port authorities, medical institutions, and travel agencies. This collaborative effort streamlined the intricate process of crew changes, ensuring that seafarers could be safely repatriated or relieved. Such measures and protocols, as implemented by leading shipping giants like Maersk, epitomize the maritime industry's dedication to the well-being of its workforce and continuity of global supply chains.

4.2 Lessons learned

The pandemic, with its many changes and challenges to standard maritime operations, highlighted both strengths and weaknesses in the EU and global maritime sector. From this experience, several key lessons have been learned as discussed below.

Adaptability and resilience

The EU maritime industry's response to the pandemic showcased a significant capacity for adaptability, especially in adjusting ship operations and crewing configurations. This adaptability, while crucial, also highlighted areas demanding enhanced resilience. EU Ports and terminals, in particular, made strategic operational adjustments to navigate the challenges, underlining the paramount importance of flexible and robust planning in maritime operations.

Preparedness and effective communication

The pandemic highlighted the importance of prior planning and clear communication. EU ports with well-established contingency and emergency plans were better positioned to address the arising challenges. Likewise, the need for timely, transparent, and effective communication became paramount, especially in scenarios that could lead to operational challenges such as delayed maintenance or issues in crew change.

- **Stakeholder collaboration:** Throughout the pandemic, the seamless coordination between various stakeholders, including shipping companies and port operators, proved pivotal in ensuring minimal disruptions. Public authorities extended crucial support, especially in safeguarding the maritime workforce, while the maritime industry's proactive measures, backed by real-time experiences, contributed to tangible solutions and insights for safety management during the crisis. Some of these solutions include the implementation of enhanced but harmonized health and safety protocols to deal with future outbreaks (health emergencies), harmonized crew quarantine measures and especially dedicated places, such as places of refuge for health

crises, and the established guidelines for adoption of digital tools for monitoring and reporting, all of which aims to contribute to maintain operational continuity and mitigating risks within the maritime sector in similar future outbreaks. The most important, outcomes expected from the stakeholder collaboration are common understanding, common acceptance and unified actions in future emergencies.

- **Need for global harmonization of regulations:** The EU, though having achieved some regulatory harmonization, faced challenges due to the global nature of shipping. The disparities in travel restrictions, vaccination requirements, and crew change protocols between countries during the COVID-19 crisis highlighted the pressing need for a more universally cohesive regulatory landscape, particularly, differing health protocols at the international level (varying between countries) and national level (varying between ports in the same country) based on different vaccinations types (mRNA vaccines, protein subunit vaccine, viral vector vaccine) or previous ports of call, confinement measures for passengers and crew for travel, and differing quarantine periods. To ensure smoother maritime operations, there is a clear call for a streamlined set of practices and standards that extend beyond the EU and are embraced globally. A global adoption of unified standards is crucial for enhancing the efficiency and effectiveness of maritime operations across borders. Moreover, it's worth noting that a harmonized framework and designated places of refuge for health issues can prove invaluable in health-related emergencies, etc.
- **Acknowledgement of seafarers and their mental health and well-being:** The pandemic highlighted the critical importance of seafarers and their mental and physical health. The industry confronted the repercussions of prolonged isolation, stress, and fatigue on its crew members. Recognizing and addressing these challenges became paramount, emphasizing the need for holistic well-being measures and sustained support for maritime personnel amid the heightened risks of the crisis. The efforts should include providing crew amenities on board (internet, on board entertainment, extra recreational equipment, organising special events, arranging extra half-day off etc.), as well as recognizing and providing their need of shore leaves, and shore medical assistance in a continuously accessible manner. Furthermore, on board crew management practices should be closely updated by following crew welfare guidance and recommendations developed by industry stakeholders¹¹⁴.

Seafarers' well-being is fundamentally rooted in three primary facets: recognition, stimulation, and certainty¹¹⁵. All three aspects appear to be lacking in harmonized adoption and implementation in the maritime industry. The COVID-19 period illustrated a wide spectrum in implementation: in some ports, seafarers were acknowledged as “key workers,” facilitating their travel and transit whereas other ports denied seafarers even the basic provision of emergency medical care, sometimes leading to tragic outcomes. Therefore, as INTERTANKO’s “Crew Welfare Management and Mental Wellness” guide suggests¹¹⁶, global recognition of seafarers is vital to ensuring that seafarers feel acknowledged and valued, thus counteracting the potential devaluation caused by isolation and a lack of contact. Stimulation is crucial for preserving vitality, especially when confronted with repetitive onboard routines that might result in fatigue or agitation. Certainty underpins safety and predictability; its absence can evoke feelings of insecurity, while excessive rigidity might induce rebellion or passivity. Effective communication is foundational to these efforts, to assure seafarers that they are well regarded and to persistently maintain open communication lines. Emphasis is suggested to be placed on routine non-work-related check-ins that focus not only on the message but also the tone - one of compassion, empathy, and clarity. Look out, reach out, leading by example framework is suggested for not only shipping companies but also all concerned parties in shipping industry. Look out accentuates the necessity for shore management to be vigilant of the crew's mental and emotional well-being, urging for timely interventions during instances of distress. Reach out emphasizes the importance of empathy and understanding, cultivating trust and alleviating stress. Leading by example underscores the role of ship management in sculpting the organizational culture via respect, acknowledgment, and support. This includes organizing events, championing healthy living, and fostering mutual well-being support to round off a comprehensive approach to seafarer welfare.

- **Technological leverage:** The role of digitalization became paramount. From facilitating remote operational management to digital platforms for documentation and communication, technology played a pivotal role in ensuring that maritime operations continued with minimal disruptions.

¹¹⁴ INTERTANKO. (2021). Crew Welfare Management and Mental Wellness. 2nd Edition. Human Element in Shipping Committee (HEiSC). https://wwwcdn.imo.org/localresources/en/MediaCentre/HotTopics/Documents/2021_Crew%20Welfare_Management_and%20Mental_Wellness_2nd-ed-web_2.pdf

¹¹⁵ Clarke, J. I., & Dawson, C. (2009). Growing up again: Parenting ourselves, parenting our children. Hazelden Publishing. Minnesota, USA.

¹¹⁶ See footnote 110 *ibid*.

An overview of the lessons learned for the maritime industry is presented in Table 19.

Table 19: Lessons learned from COVID-19 for the maritime industry

Lessons learned	Key takeaways
Adaptability and resilience	<ul style="list-style-type: none"> Importance of flexibility and robust planning in maritime operations Strategic operational adjustments to respond global lockdowns
Preparedness and effective communication	<ul style="list-style-type: none"> Necessity of established and harmonized contingency plans Importance of clear, timely, and effective communication Preparedness to handle miscommunications and related operational challenges Importance of clear and harmonized protocols for unprecedented scenarios
<ul style="list-style-type: none"> Stakeholder collaboration 	<ul style="list-style-type: none"> Pivotal role of seamless coordination across stakeholders Need for common understanding and unified actions in emergencies
<ul style="list-style-type: none"> Need for global harmonization of regulations 	<ul style="list-style-type: none"> Urgency for cohesive regulatory standards worldwide Benefits of a harmonized approach to Places of Refuge for health crises and other emergencies
<ul style="list-style-type: none"> Acknowledgement of seafarers, their mental health and well-being 	<ul style="list-style-type: none"> Critical importance of recognizing seafarers' contributions Necessity for holistic well-being measures and sustained support
<ul style="list-style-type: none"> Technological leverage 	<ul style="list-style-type: none"> Significant role of digitalization in maintaining operational continuity and managing crises




4.3 Risk Mitigation Measures

Drawing from the lessons learnt, and considering the potential safety issues and emerging risks identified in the study vis-à-vis their potential impact and degree of transience, this sub-section aims to present a set of risk mitigation measures. These mitigation measures are designed to address the safety concerns, and strengthening maritime safety against unforeseen safety challenges that may arise in the future.

Mental health and well-being initiatives

Considering the heightened stress and fatigue (SI8), comprehensive mental health initiatives, including, collection of data related to seafarers' mental health related issues, access to counselling and regular check-ins, become paramount for maintaining ship crew members' morale and well-being.




Table 20: Industry best practices: Mental health and well-being

	A container shipping line introduced a monthly well-being survey, collecting data on general crew morale while ensuring the anonymity of individual responses. This practice enabled the company to detect specific areas of concern and adjust their mental health initiatives accordingly, resulting in a noticeable decrease in reported stress incidents over time.
	A cruise ship operator collaborated with telehealth services to facilitate virtual counselling sessions for the crew. This round-the-clock access to professionals, regardless of the ship's location, significantly supported crew members in managing stress and improved overall feedback about well-being during subsequent reviews.
	A tanker operator implemented routine mental health check-ins, wherein higher-ups would engage in informal conversations about the crew's well-being. This proactive measure not only allowed early detection of potential challenges but also strengthened a supportive and open culture onboard, resulting in a reduction in mental health-related leaves.

Behavioural and risk perception training

Confronting the transformation in seafarer behaviours (SI1) and the evident shift in risk perception (SI4) demands an integrated training approach. Targeted training programs should be designed to instil best practices and standard protocols, addressing the behavioural changes that have emerged. Simultaneously, continuous awareness programs are essential to equip crews and authorities with the tools and knowledge they need to effectively navigate and adapt to evolving risks.



Table 21: Industry best practices: Behavioural and risk perception training

	<p>A maritime training institute launched a digital platform offering modules on evolving risks, from environmental hazards to cybersecurity threats. These modules, accessible from anywhere, enabled seafarers to stay updated with the latest challenges and their mitigation strategies.</p>
	<p>An NGO organized periodic workshops focusing on risk perception. Using real case studies, they highlighted the consequences of misjudging risks and the benefits of correct risk evaluation. The aim was to calibrate the crew's risk assessment abilities, ensuring that they can make better-informed decisions during operations.</p>
	<p>An offshore drilling company instituted a practice wherein after every significant operation or voyage, crew would provide feedback on any new risks they perceived or behavioural challenges they faced. This feedback was then used to design the next set of training modules, ensuring that the training was always relevant and timely.</p>

Skill development, retention, and mentorship

As the maritime industry faces the challenge of diminishing collective experience (SI11) and potential skills erosion (SI16), a comprehensive approach that integrates retention, mentorship, and continuous training becomes imperative. Retention incentives, paired with mentorship programs, can help in retaining seasoned seafarers, ensuring the seamless transfer of their invaluable expertise. To further counteract the loss of knowledge transfer (SI18), structured mentorship programs should be established. This commitment to mentorship, combined with continuous onboard drills and refresher courses, guarantees that crews not only preserve existing skills but also acquire new knowledge, ensuring they remain adept in their roles.



Table 22: Industry best practices: Skill development, retention and mentorship

	<p>A container shipping company introduced a long-term incentive program. Seafarers who completed a certain number of years with the company were provided with additional benefits such as extended leave, educational opportunities for family members, and priority in selecting routes. This not only helped retain experienced staff but also made the company more attractive to new recruits.</p>
	<p>A tanker company developed a structured mentorship program, pairing seasoned captains and engineers with new recruits. These relationships facilitated hands-on training during voyages, ensuring that invaluable expertise was passed down. Feedback mechanisms were in place to adjust the program based on mentee's inputs and mentor's observations.</p>

Safety culture and teamwork enhancement

Addressing the potential dilution of safety culture (SI12) and the challenges of teamwork (SI14) in maritime operations requires a multifaceted approach. Periodic workshops, training sessions, and campaigns should be conducted to emphasize the paramount importance of safety culture. Simultaneously, investment in team-building exercises and collaborative platforms becomes essential to foster unity and ensure seamless ship operations.


Table 23: Industry best practices: Safety culture and teamwork enhancement

	<p>A bulk carrier company instituted quarterly safety culture workshops. During these sessions, real-life incidents were dissected, with crew members actively participating in discussions to identify what went wrong and how such incidents could be prevented. This practice not only improved understanding but also fostered a proactive safety mindset.</p>
	<p>An offshore support vessel operator organized monthly team-building activities. These ranged from group problem-solving challenges to recreational activities that required coordination. Such exercises enhanced camaraderie, trust, and collaboration among the crew members.</p>

Standardization of transit and regulatory frameworks

Tackling both the disparities in seafarers' transit rights (SI2) and the complexities of an unharmonized regulatory landscape (SI3) necessitates a cohesive approach towards standardization. A unified seafarer travel policy, nurtured through international collaboration, can assure both operational fluidity and the welfare of seafarers. Concurrently, international maritime bodies must ardently work towards implementing standardized guidelines, promoting a safer and more coordinated global maritime operation.



Table 24: Industry best practices: Standardization of transit and regulatory frameworks

	<p>Several countries collaborated to establish a standardized seafarer travel document through bilateral and multilateral agreements. This document acted as a universal pass, allowing seafarers to move across these countries' ports without needing separate visas or permits. This initiative not only streamlined operations but also safeguarded seafarers' rights and reduced administrative burdens.</p>
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Comprehensive risk assessment and communication

In the face of a multifaceted post-pandemic risk landscape (SI6) and the exigency of prompt risk communication (SI10), a two-fold approach is vital. Firstly, evolving dynamic risk assessment frameworks, which seamlessly integrate emerging technologies and contemporary operational paradigms, are pivotal for adept navigation. Concurrently, the institution of advanced real-time communication platforms stands paramount to promptly address and mitigate emerging risks and challenges.


Table 25: Industry best practices: Comprehensive risk assessment and communication

	<p>A shipping company integrated AI-driven predictive analytics into its risk assessment framework. This tool scanned global news sources, weather predictions, and port updates to anticipate disruptions. As a result, the company could proactively reroute ships or adjust schedules to avoid foreseeable challenges, leading to improved punctuality and reduced operational costs.</p>
	<p>A tanker company, understanding the constraints of physical training during the post-pandemic phase, introduced virtual reality (VR) based risk assessment drills. Crew members could simulate various risk scenarios in a virtual environment, enhancing their preparedness for real-world challenges.</p>

Resilience in crisis management and supply chain

Recognizing the imperative nature of resilience (SI15) and the altered supply chain dynamics (SI13), a combined strategy is indispensable. Firstly, regular simulation of potential crisis scenarios allows the industry to evaluate and enhance its response strategies. Simultaneously, by diversifying suppliers and nurturing strategic partnerships, the maritime sector can bolster its supply chain resilience, ensuring uninterrupted operations even in the face of global upheavals.

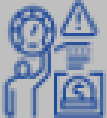

Table 26: Industry best practices: Resilience in crisis management

	<p>In light of the challenges posed by COVID-19, which included confinement of ill passengers and crew on ships, there is a compelling need to consider the potential use of Places of Refuge¹¹⁷ in cases of health emergencies, such as the COVID-19 pandemic, which could offer several advantages including quarantine and medical assistance besides humanitarian consideration¹¹⁸, and a coordinated and standardized response.</p>
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Cybersecurity protocols and measures

Addressing rising cyber vulnerabilities (SI7) requires robust investment in cutting-edge cybersecurity solutions and frequent system audits to safeguard essential navigation and communication systems.



Table 27: Industry best practices: Cybersecurity protocols and measures

	<p>A global shipping company introduced quarterly cyber drills, simulating real-world hacking scenarios. This training, offered both virtually and in-person, educated their crew and staff on potential cyber threats, ensuring they were well-equipped to recognize and respond to malicious activities.</p>
	<p>An oil tanker operator regularly conducted third-party cybersecurity audits and penetration tests. These exercises identified potential vulnerabilities in their systems, leading to timely remediation and bolstering of their cyber defences.</p>

Trust-building measures

To counteract trust erosion (SI9), efforts like transparent communication, consistent feedback mechanisms, and tangible welfare assurances can serve to rebuild foundational trust.

Table 28: Industry best practices: Trust-building measures

	<p>A ferry operator rolled out a digital feedback platform, allowing crew members to provide anonymous feedback on a range of topics, from onboard facilities to safety concerns. Monthly reviews of this feedback led to iterative improvements, making crew members feel valued and listened to.</p>
	<p>An offshore supply vessel company, in a bid to ensure crew welfare, set up a dedicated welfare fund. This fund was designed to support crew members facing financial difficulties or emergencies. Knowing that such a safety net existed significantly boosted trust and loyalty towards the company.</p>

¹¹⁷ EMSA. (2023). Places of Refuge. <https://www.emsa.europa.eu/we-do/safety/places-of-refuge.html#:~:text=A%20%22place%20of%20refuge%22%20means,for%20accommodating%20ships%20in%20distress>.

¹¹⁸ Humanitarian considerations: Confining passengers and crew on board a ship during a health emergency can lead to complicated humanitarian situations. Places of Refuge can offer a more humane alternative, ensuring that individuals have access to basic necessities and appropriate living conditions.

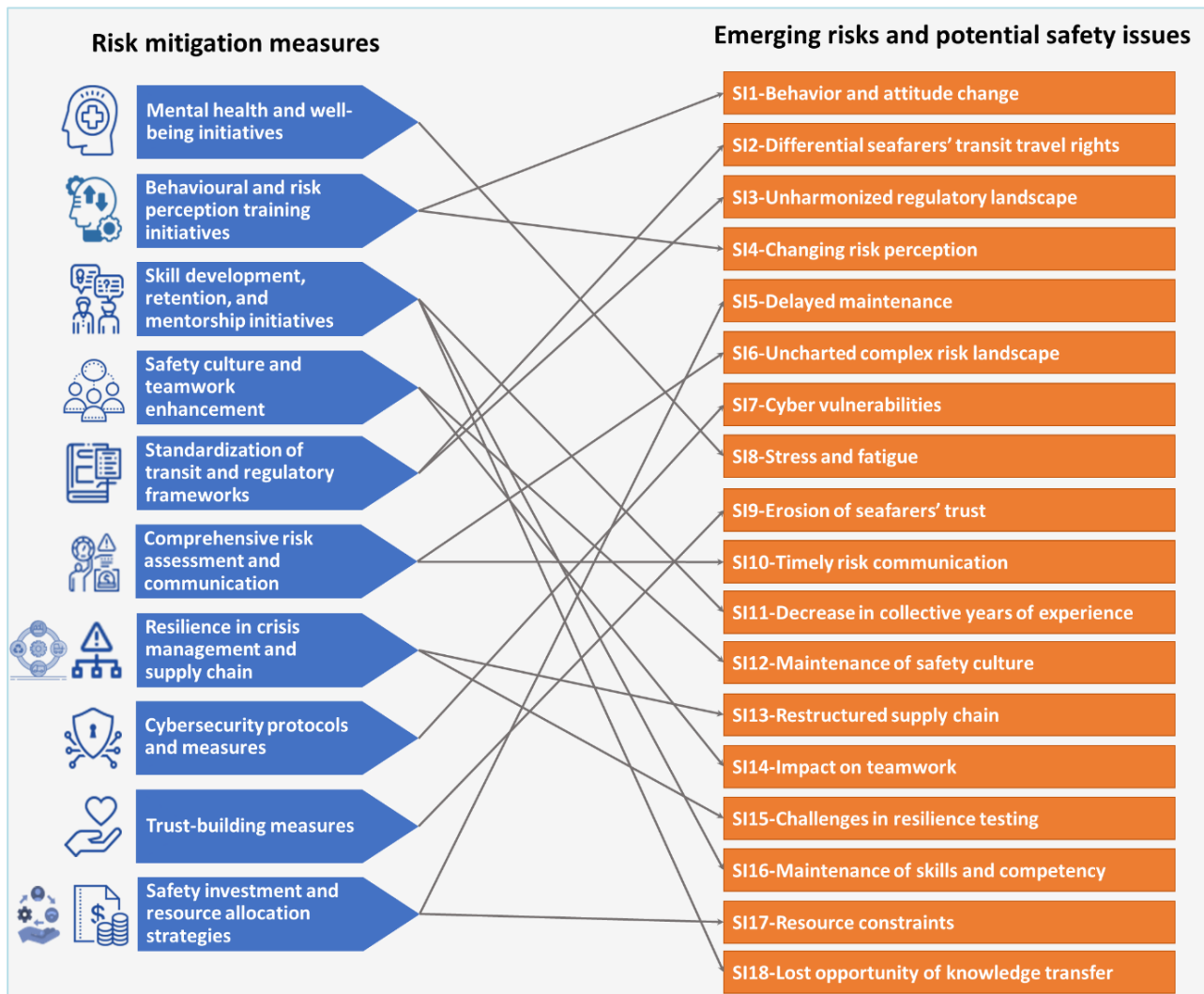
Safety investment and resource allocation strategies

Considering the resource constraints (SI17) affecting particularly small companies, strategic allocation, budgeting, and external partnerships can be effective strategies to maintain crucial areas like maintenance (SI5), and safety.

Interrelation between the detected safety issues and proposed risk mitigation measures

Figure 22 presents the interrelation between the emerging risks and potential safety issues and risk mitigation measures as outlined above. By implementing these risk mitigation measures, the EU and global maritime sector can be better prepared for future challenges, ensuring that operations continue seamlessly and that both crew and cargo are safeguarded effectively in the future outbreaks similar to COVID-19.

Figure 22: Interrelation between the safety issues and risk mitigation measures



4.4 Identifying stakeholders' actions to mitigate future risks

The complexity of challenges facing the EU maritime sector necessitates major stakeholders collaborate to ensure resilience and safety. Therefore, the study aligns the proposed risk mitigation measures with the key stakeholder groups of the maritime industry as presented in Section 4.1. with respect to the Rasmussen's risk management framework.

Table 29 presents proposed risk mitigation actions by key maritime stakeholder groups. By assigning roles and responsibilities across these stakeholder groups, the EU maritime sector can pursue a comprehensive, coordinated approach, ensuring that future challenges, like those presented by the COVID-19 pandemic, are navigated safely and effectively.

Table 29: Proposed risk mitigation actions by key maritime stakeholder groups

Group	Stakeholder	Risk mitigation actions
Organizational level	Intergovernmental and international organizations	<ul style="list-style-type: none"> ▪ Standardise transit and regulatory frameworks for safer global maritime operations ▪ Spearhead the development of risk assessment tools and promote advanced communication platforms ▪ Collaborate on campaigns and initiatives reinforcing safety culture
	Regional regulating bodies	<ul style="list-style-type: none"> ▪ Develop funding initiatives and policy frameworks to further prioritize safety, especially for smaller entities ▪ Foster harmonised seafarer transit policy in collaboration with member states and maritime bodies ▪ Identify and establish precursors of safety issues and emerging risks and maintain close monitoring of their evolution ▪ Standardise operational frameworks for enhanced safety of maritime operations ▪ Spearhead development of risk assessment tools and promote advanced communication platforms ▪ Collaborate on campaigns and initiatives reinforcing safety culture
Control level	Ship owners and operators	<ul style="list-style-type: none"> ▪ Implement comprehensive mental health programs, counselling, and regular check-ins ▪ Allocate resources for safety and maintenance, especially for smaller entities ▪ Invest in cutting-edge cybersecurity solutions and frequent system audits
	Supply chain partners and logistic companies	<ul style="list-style-type: none"> ▪ Diversify supplier networks and foster strategic partnerships ▪ Simulate crisis scenarios to refine response strategies
Individuals level	Crew welfare associations and seafarer support organizations	<ul style="list-style-type: none"> ▪ Drive transparent communication, consistent feedback mechanisms, and welfare initiatives to promote trust ▪ Host safety culture workshops and teamwork enhancement initiatives
	Maritime education and training institutes	<ul style="list-style-type: none"> ▪ Facilitate targeted training programs addressing seafarer behavioural shifts and risk perceptions ▪ Develop onboard drills, ashore refresher courses, and mentorship programs ▪ Host safety culture workshops and teamwork enhancement initiatives

5. Conclusions

The COVID-19 pandemic presented an unprecedented global challenge, significantly affecting every industry, including the maritime industry. Maritime transport, integral to global trade, had to rapidly adapt to ensure the continuity of its operations amidst the pandemic. The enforcement of stringent health and safety measures and the imposition of numerous restrictions had profound impacts, particularly, on seafarers and shipping companies' personnel. Consequently, maritime operations worldwide had to deviate from established norms and practices, navigating through the uncertainty brought about by the pandemic.

Exploration of the maritime industry's multifaceted response to the pandemic revealed the intricate interplay between human resilience, technological adaptation, and operational challenges. Crew members, for instance, faced extended contracts, disrupted routines, and mental health impacts. The pivot to remote operations, furthermore, brought efficiency but underscored the indispensability of on-site inspections for a complete understanding of shipboard conditions. The transition to a technologically integrated future was marked by a shift towards remote surveys, online training, and digital communication, which was crucial in ensuring continuity while emphasising safety. The adaptive practices necessitated by the COVID-19 pandemic, while essential, were not entirely free from safety trade-offs.

The study identified eighteen different safety issues that emerged as a consequence of the COVID-19 pandemic's influence on the maritime sector categorised across three distinct layers: organisational, control, and individual corresponding to the levels of targeted interventions. At the organisational level, the associated safety issues identified are differential seafarers' transit travel rights, an unharmonized regulatory landscape, changing risk perception, an uncharted complex risk landscape, timely risk communication, a restructured supply chain, and challenges in resilience testing. On the control level, identified issues comprise delayed maintenance, heightened cyber vulnerabilities, and the maintenance of safety culture—a concern that extends to the individual level as well. Additionally, the individual level is marked by changes in behaviour and attitude, the erosion of seafarers' trust, the retention of skills and competency, increased stress and fatigue, a reduction in cumulative experience, adverse effects on teamwork, and missed chances for knowledge transfer.

Examination of the transient and persistent nature of the identified safety issues revealed a decline over time in issues such as behaviour and attitude change, unharmonized regulatory landscape, cyber vulnerabilities, maintenance of safety culture, restructured supply chain, and lost opportunities for knowledge transfer, suggesting that industry responses or strategic actions might be effectively addressing these, thereby highlighting their transient nature. Conversely, challenges such as differential seafarers' transit travel rights and changing risk perception remain persistent, hinting at potential deep-rooted issues or aspects not encompassed by the current study.

The identified early warning indicators exhibit a proactive stance in risk management, potentially enhancing safety and operational continuity. Integral to this approach is the significant importance of collecting data on seafarers' behavioural trends, job satisfaction, cybersecurity incidents, and crew mental health records, which are critical for tracking emerging safety issues and identifying and prioritising mitigation measures.

Risk mitigation requires an industry-wide commitment to resilience and preparedness for future emergencies. At the core of the proposed mitigation measures is a focus on seafarers' mental health, the cultivation of a safety culture, and the assurance of continuous skill development. Specific mitigation measures at the organisational level include standardising transit and regulatory frameworks, developing risk assessment tools, prioritising safety, and promoting advanced communication platforms for global maritime safety. The control level involves establishing mental health programs, investing in cybersecurity, and conducting regular system audits. At the individual level, measures include enhancing transparent communication, implementing feedback mechanisms, initiating welfare programs, and conducting workshops to foster a safety culture and teamwork. Adopting such measures would better help the maritime industry to face a broad spectrum of potential future crises.

The lessons drawn from the maritime industry's experience of the COVID-19 period are manifold. They spotlight the necessity for adaptability, where strategic pivots in operations and crew management have underscored the robustness of maritime infrastructure. The pressing need for preparedness and effective communication has been accentuated, with the most adept ports displaying exemplary handling of the crises. Increased stakeholder collaboration fostered harmonised safety measures and a shift towards digital solutions, ensuring the flow of

maritime operations. Moreover, the push for global harmonisation of regulations emerges as a salient point, hinting at the potential for streamlined governance to alleviate future disruptions. The pandemic has also magnified the significance of seafarers' mental health, catalysing a more humane lens on maritime labour. Lastly, the technological strides made in digital documentation and remote management signify a leap towards a more resilient and efficient future for maritime operations. As the industry navigates forward, these lessons forge a beacon, guiding a path toward a more unified, considerate, and technologically advanced maritime world, better prepared for future crises.

The findings of this study offer a pivotal contribution to an understanding of the COVID-19 pandemic's impact on EU maritime transport. By charting the emergent safety concerns and risks, and proposing targeted mitigation strategies, this study lays the groundwork for reinforcing the resilience of the EU's maritime sector. The path ahead for EU maritime stakeholders is clear: to integrate these lessons into a cohesive safety and operational framework, elevating the standard of preparedness and ensuring that the welfare of seafarers remains at the forefront. This study's recommendations are a call to action for harmonised safety protocols such as place of refuge for ships with human health crisis and enhanced collaborative efforts across the EU, forming the cornerstone of a proactive and resilient maritime infrastructure, capable of navigating future challenges with agility and assurance.

Appendix A Research design

Data collection approach

To ensure a comprehensive research scope, the project methodology embraced a mixed-method approach, breaking down the process into specific work packages.

- **Desktop research – Work Package 1 (WP1):** In this phase, the research team concentrated on a systematic review of official documents from official entities and academic literature. Through a thematic analysis, the goal was to draw out and present the central themes and patterns related to the project's scope in a comprehensive and detailed manner.
- **Interviews – Work Package 2 (WP2):** Interviews targeted a range of participants, including seafarers/fishers and shipping/fishing company personnel, such as DPAs, human resource managers, as well as technical superintendents.
- **Questionnaire survey – Work Package 3 (WP3):** A detailed questionnaire was developed for seafarers, encompassing both quantitative (using a Likert scale) and qualitative questions (open-ended questions). The content was shaped by a comprehensive literature review and insights from the interview phase.
- **Focus group workshop – Work Package 4 (WP4):** A focus group discussion was held on 18 August 2023 at the World Maritime University with participation of 15 experts. Participants included representatives from organizations of shipowners, seafarers, and fishers. The session's objectives were multifaceted: to review and validate study results, to discuss the risk and safety challenges that arose during the COVID-19 outbreak, and to project future implications and trajectories.

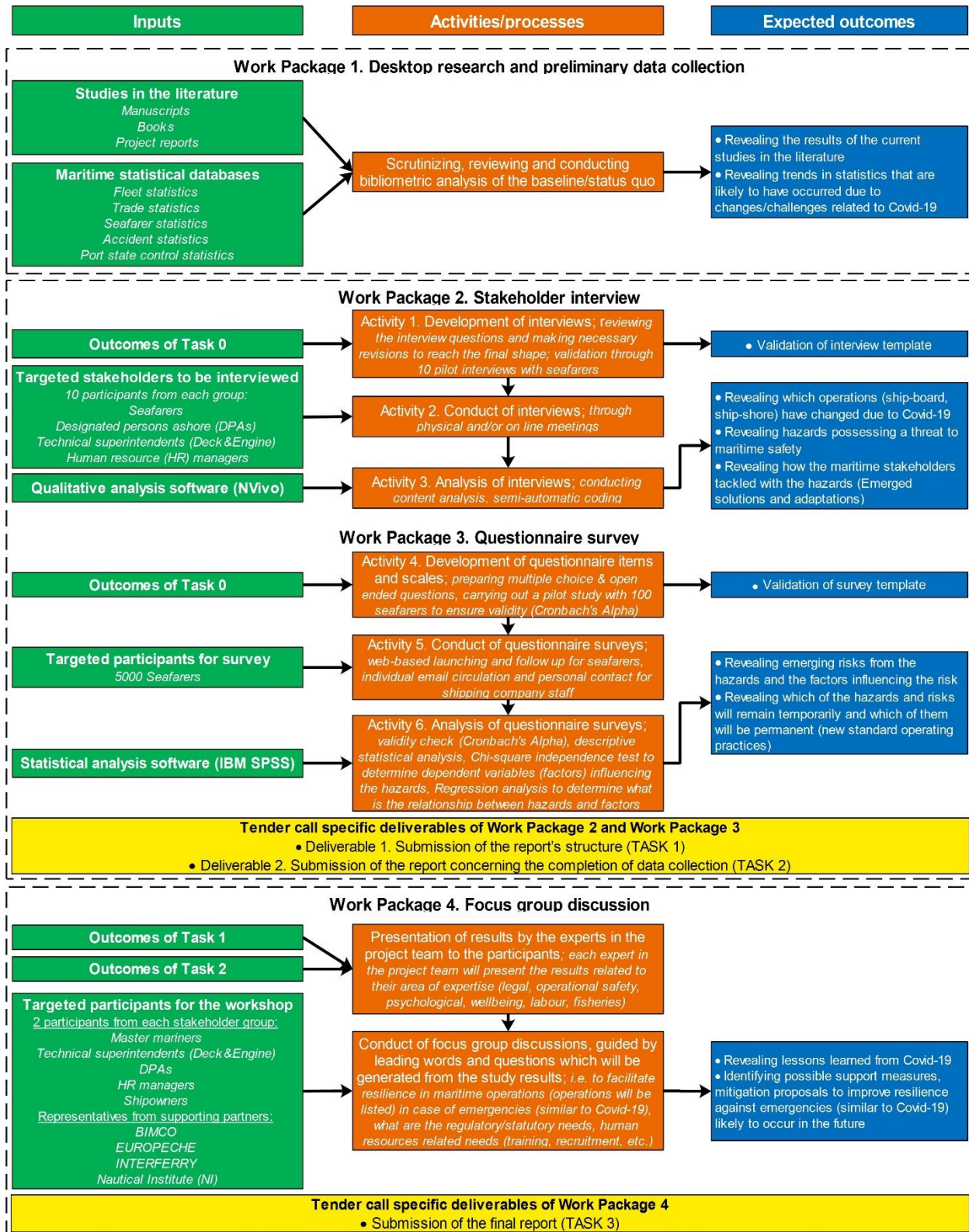
Data sources

- **Primary:** At the core of the research were personal interviews and an online questionnaire tailored for the commercial shipping and fishing industry's stakeholders, from seafarers and DPAs to managers in technical and HR domains.
- **Secondary:** This comprised literature reviews, reports from key organizations, statistics, country profiles, and maritime accident investigation reports relevant to the COVID-19 period.

Research insights

Engagement with seafarers and fishers commenced with semi-structured interviews to capture nuanced perceptions. The online survey, which followed, aimed to cast a wider net for diverse perspectives, encompassing areas from onboard workload and fatigue to the socio-psychological impacts of COVID-19. Parallely, interactions with shipping companies and fishing enterprises personnel offered a dual lens: technical and operational. DPAs provided a critical bridge, highlighting the operational challenges amidst the pandemic

Figure 1. Flow chart of the methodology



Validity of the study

The study's research design hinged on a mixed-method approach, which adeptly yielded comprehensive insights and nuanced details in line with the research objectives. Both the semi-structured interview questions and online survey inquiries were thoughtfully curated, addressing content and structural dimensions, and were rigorously vetted through a pilot study.

Moreover, the strategic inclusion of diverse stakeholders—ranging from junior and senior officers, ratings, Designated Persons Ashore (DPAs), technical superintendents, to technical and human resources managers—bolstered the reliability and validity of the research outcomes. This meticulous approach aimed to produce thorough and trustworthy findings.

By intertwining a mixed-method approach, validating research tools with precision, and engaging with pertinent stakeholders, this study aspires to be a meaningful addition to existing knowledge. It seeks to offer precious insights, thereby enriching the academic discourse in this realm.

Researchers' positionality

The World Maritime University has assembled a dedicated and proficient team of 11 members to execute this study. The team comprises a Project Manager (PM), five Senior Data Analysts (SDA), and five Data Analysts (DA). Each member contributes specialized expertise and experience, aligning with the research's objectives.

The team's expertise spans a variety of sectors, including maritime safety and risk, resilience, law, and psychology. This diversity ensures a thorough, multidisciplinary approach in addressing the research's aims and questions.

Each member's role and responsibilities are clearly demarcated to optimize their input and expertise. The PM supervises the study's overarching coordination and management, guaranteeing seamless communication and consistent progress. The Senior Data Analysts and Data Analysts are instrumental in data collection, analysis, and interpretation, utilizing their specialized acumen to extract significant findings.

Further enriching the team's capabilities is a legal expert who sheds light on the maritime industry's regulatory and legal nuances, and a psychology expert who offers insights into the psychological well-being of maritime personnel.

Harnessing the collective expertise and synergy of this diverse group, the study is poised to deliver an exhaustive and enlightening exploration into COVID-19's impact on maritime safety and related fields.

Ethical consideration

Ethical considerations were paramount in this study, especially given the personal nature of the interviews and questionnaires. To ensure adherence to the highest ethical standards, both the survey questionnaire and interview protocols were meticulously reviewed by the WMU Research Ethics Committee. The research rigorously prioritized the protection of participants' rights, ensuring their privacy, confidentiality, and factors such as anonymity and data protection. Participants were also granted the right to withdraw from the study at any stage. Participation was entirely voluntary, and no fees were associated with it. Approval from the WMU Research Ethics Committee was secured before initiating any data collection.

Limitations

Like all research endeavours, this study comes with its own set of strengths and limitations that merit acknowledgment. A significant limitation that emerged during the data collection phase, particularly during interviews, was the time gap since the pandemic's onset in spring 2022. Some participants found it challenging to recall their experiences during the peak of the COVID-19 crisis accurately. This recall bias might have affected their perspectives on the various aspects explored in the study, such as fatigue, stress, and anxiety.

Another inherent limitation is tied to the nature of survey research, which depends on self-reported data. As a result, it was not always possible to delve into the depths of participants' experiences beyond their provided answers. Given this limitation, it is recognized that both seafarers and personnel from shipping companies might not have fully disclosed their true perceptions, beliefs, opinions, and emotions in response to the questions.

By shedding light on these limitations, the study offers a transparent evaluation of potential challenges that might have impacted the data collection and subsequent analysis. This acknowledgment aids in a more comprehensive interpretation of the research outcomes.

Appendix B The study surveys

Interview questions for seafarers

1. COVID-19 vs support to seafarers from companies and governments. The following questions aim to investigate the perceived support to seafarers from their shipping companies and other maritime stakeholders.

- 1.1. Could you please comment on how your shipping company supported seafarers during COVID-19 (e.g., crew exchange, provision supply, mental health support, access to health care)?
- 1.2. Could you please comment on your government's support to seafarers during COVID-19, regarding crew exchange, provision supply, mental health support, and access to health care?
- 1.3. Could you please comment on your embarkation/disembarkation experiences (including challenges) during COVID-19?

2. COVID-19 vs seafarers' well-being. The following questions investigate the change in social life and well-being of seafarers during COVID-19. Then, the relationship between seafarers' well-being during COVID-19, including their psychological states, and performance in work and safety will be investigated. Below are the leading questions in this respect.

- 2.1. Could you please elaborate on how the different measures imposed by the pandemic (social distancing, the extension of contact without willing, restricted shore leave, etc.) affected your onboard social life and psychological state (stress, anxiety)?
- 2.2. How did/ does the psychological state of the crew members on board your ship affect the safe performance of tasks within the team?
- 2.3. Have you experienced any incident on your ship because of these psychological states? If yes, can you please elaborate?

3. COVID-19 vs workload. Questions under this subject aim to investigate the change in the workload of seafarers due to COVID-19, the causes of this change, and whether the increase in workload affected seafarers' safety practices.

- 3.1. Could you please describe the changes in your workload due to COVID-19 (multi-tasks, fatigue, safe manning, etc.)?
- 3.2. How does the change in your workload affect the teamwork safety practices in performing tasks (checklist, preparation prior-operations, briefing/debriefing, watch handover, etc.)?

4. COVID-19 vs violation of rules and procedure. Deviation from operation and safety standards and procedures will be investigated through following the leading questions below.

- 4.1. Could you please elaborate on the major deviations from safety and operating standards/procedures you have faced in your ship during COVID-19 to get the work done?
- 4.2. Could you please comment on how your company's Safety Management System reflected the changes in duties and responsibilities because of changes in operations due to COVID-19?
- 4.3. Have you experienced any incidents because of these deviations? If yes, please elaborate.

5. COVID-19 vs remote monitoring of fleet. The questions under this subject will investigate the efficiency and possible safety implications of virtual and remote surveys and inspections, and also remote alternatives or extensions of the expiry date related to Training and certification of seafarers (STCW). Leading questions are outlined below in this respect.

5.1. Could you please elaborate your experience as a seafarer with implementation of the alternative options during COVID-19 such as remote surveys/training and extensions of certificates to maintain the minimum safety standards (safety of life and environmental safety) on board ships, as required by national and international regulations?

5.2. Could you please comment on the effectiveness and efficiency of these alternative options in ensuring the minimum safety standards (safety of life and environmental safety) on board ships, as required by national and international regulations?

6. *COVID-19 vs attractiveness of seafaring career.* This subject will examine the implications of different issues during COVID-19 believed to affect seafarers' career and their job satisfaction such as crew change crises, extended contract periods, and financial challenges and uncertainties. Leading questions for personal interviews with seafarers related to their seafaring careers presented below.

6.1. How and in what ways has COVID-19 affected your thinking about your future career plans as a seafarer?

6.2. Does COVID-19 trigger in your mind any intention to change jobs? Can you please elaborate?

Interview questions for shipping companies' staff

1. *COVID-19 vs shipboard and management commitment toward safety.* These questions will investigate implications of changes in business-as-usual practices regarding ship-shore operations on the organizational safety culture, safety commitment of the companies' management level.

1.1. Could you please describe the ship-shore operations in your company/fleet that required a deviation or modification due to COVID-19 from normal operations?

1.2. Could you please describe to what extent your shipping company maintained its commitment to safety during COVID-19?

1.3. Could you please comment on the shipboard personnel and how they maintained their commitment to safety during COVID-19?

2. *COVID-19 vs fulfilment of safety obligations.* Questions under this subject area will examine the way the shipping companies managed to fulfil their obligations related to ensuring safety inspections, audits, and certifications during and following COVID-19 period.

2.1. Could you please explain how your company managed to fulfil the safety-related obligations such as audits, inspections, surveys, training, and ship and seafarer's certification during COVID-19?

2.2. Could you please comment on the challenges you faced, as a coordinator between ship and shore, to facilitate the conduct of ship inspections and surveys?

2.3. Could you please comment on the availability of classification surveyors to intervene on ships during COVID-19?

3. *COVID-19 vs seafarers' well-being.* Shipping companies' perspectives through the eyes of shipping company staff (DPA/HR Manager/Technical Superintendent etc.), will be examined by using the leading questions under this subject area.

3.1. Could you please comment on your experience as shipping company staff (DPA/HR Manager etc.) in facilitating crew change, seafarer repatriation, and shore leave?

3.2. Could you please comment on the challenges you have faced to ensure seafarers' access to medical services ashore?

3.3. Could you please comment on your interaction and relationship with seafarers during COVID-19 (e.g., was it challenging to interact with them because of their level of stress for example)?

3.4. Could you please comment on the change in the frequency of psychological and mental support sought by seafarers during COVID-19?

4. COVID-19 vs ships' maintenance. Questions under this subject area will investigate potential implications of challenges occurred during and following COVID-19 period related to onboard planned maintenance (i.e., provision of original spare parts, urgent repair interventions, periodical dry-dockings liabilities, and conflicts between stakeholders etc.).

4.1. How did your company manage to ensure the provision of original spare parts, urgent repair intervention on ships, and dry-docking during COVID-19?

4.2. Could you please elaborate on any delays in periodic inspections of critical equipment during COVID-19?

4.3. Could you please comment on the responsibilities, liabilities, and conflicts that emerged between manufacturers, classification societies, shipping companies, and maritime administrations as a result of the delays in maintenance during COVID-19, etc.?

5. COVID-19 vs lessons learned and resilience. Questions under this subject area will investigate the best practices and lessons learned to enhance safety and improve resilience against emergencies likely to occur in the future, similar to COVID-19.

5.1. Could you please comment on the changes in your company in terms of policies, strategies, plans, procedures, and practices due to COVID-19?

5.2. Could you please comment on how your company learned to shift effectively from business as usual to emergency practices without jeopardizing safety?

Interview questions for fishing industry

1. COVID-19 vs shipboard and management commitment toward safety. These questions will investigate implications of changes in business-as-usual practices regarding ship-shore operations on the organizational safety culture, safety commitment of the companies' management level.

1.1. Could you please describe the ship-shore operations in your company/fleet that required a deviation or modification due to COVID-19 from normal operations?

1.2. Could you please describe to what extent your fishing company maintained its commitment to safety during COVID-19?

1.3. Could you please comment on the shipboard personnel and how they maintained their commitment to safety during COVID-19?

2. COVID-19 vs fulfilment of safety obligations. Questions under this subject area will examine the way the fishing companies managed to fulfil their obligations related to ensuring safety inspections, audits, and certifications during and following COVID-19 period.

2.1. Could you please explain how your company managed to fulfil the safety-related obligations such as audits, inspections, surveys, training, and ship and seafarer's certification during COVID-19?

2.2. Could you please comment on the challenges you faced, as a coordinator between ship and shore, to facilitate the conduct of ship inspections and surveys?

2.3. Could you please comment on the availability of classification surveyors to intervene on ships during COVID-19?

3. COVID-19 vs fishermen' well-being. Fishing companies' perspectives through the eyes of fishing company staff (DPA/HR Manager/Technical Superintendent etc.), will be examined by using the leading questions under this subject area.

3.1. Could you please comment on your experience as fishing company staff (DPA/HR Manager etc.) in facilitating crew change, seafarer repatriation, and shore leave?

3.2. Could you please comment on the challenges you have faced to ensure seafarers' access to medical services ashore?

3.3. Could you please comment on your interaction and relationship with seafarers during COVID-19 (e.g., was it challenging to interact with them because of their level of stress for example)?

3.4. Could you please comment on the change in the frequency of psychological and mental support sought by seafarers during COVID-19?

4. *COVID-19 vs ships' maintenance.* Questions under this subject area will investigate potential implications of challenges occurred during and following COVID-19 period related to onboard planned maintenance (i.e., provision of original spare parts, urgent repair interventions, periodical dry-dockings liabilities, and conflicts between stakeholders etc.).

4.1. How did your company manage to ensure the provision of original spare parts, urgent repair intervention on ships, and dry-docking during COVID-19?

4.2. Could you please elaborate on any delays in periodic inspections of critical equipment during COVID-19?

4.3. Could you please comment on the responsibilities, liabilities, and conflicts that emerged between manufacturers, classification societies, fishing companies, and maritime administrations as a result of the delays in maintenance during COVID-19, etc.?

5. *COVID-19 vs lessons learned and resilience.* Questions under this subject area will investigate the best practices and lessons learned to enhance safety and improve resilience against emergencies likely to occur in the future, similar to COVID-19.

5.1. Could you please comment on the changes in your company in terms of policies, strategies, plans, procedures, and practices due to COVID-19?

5.2. Could you please comment on how your company learned to shift effectively from business as usual to emergency practices without jeopardizing safety?

Questionnaire survey to detect potential covid-19-related safety issues and emerging risks contributing to marine casualties and incidents

Dear Participant,

Thank you for accepting to be part of this study conducted by the World Maritime University for the European Maritime Safety Agency, under the title: Study to detect potential COVID-19-related safety issues and emerging risks contributing to marine casualties and incidents. The study aims to provide insight and figures on the potential impact of COVID-19 on shipping safety, including the seafarers' well-being and ship operations. The survey includes 13 questions, where you are asked to provide your valuable insights about various statements connected to the study. It will take between 5-10 minutes to answer all the questions. When answering the questions, please refer to your sailing period during Covid-19.

This research has been reviewed and approved by the World Maritime University Research Ethics Committee. If you have any additional questions or concerns about this project, please contact:

Dr. Anish Hebbar
Principal Investigator EMSA Covid-19 project
Assistant Professor (Maritime Safety)
World Maritime University
E-mail: ah@wmu.se

Participant's background information

Gender: Age: Nationality (Country):

During Covid-19, I have sailed onboard (type of ship):

1. Dry cargo ship
2. Tanker ship
3. Container ship
4. Passenger ship
5. Fishing vessel
6. Other _____

I have a sailing experience of:

1. Less than 5 years
2. 5-10 years
3. 11-15 years
4. 16-20 years
5. More than 20 years

My rank/position:

1. Officer-Deck Department
2. Officer-Engine Department
3. Rating-Deck department
4. Rating-Engine department
5. Catering/Hotel Department
6. Skipper

During Covid-19 period, I have sailed onboard EU flagged ships: Yes/ No

During Covid-19 period, my ship(s) called in EU ports: Yes/ No

Survey Part A. Perceived workload, work performance, and safety onboard

Q1. During Covid-19, we have experienced an additional workload in duty onboard our ship, compared to the pre-Covid business as usual, due to:

1. Shore tasks performed by the crew
2. Unavailability of crew because of Covid-19 infections/ other illnesses
3. Reduced crew onboard
4. Remote audits and surveys
5. Physical distancing
6. Other

Q2. During Covid-19, I have experienced higher level of stress/anxiety, compared to the pre-Covid business as usual:

1. Always
2. Often
3. Sometimes
4. Rarely
5. Never
6. No answer

Q3. During Covid-19, my hours of rest were less respected onboard, compared to the pre-Covid business as usual:

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly disagree

Q4. During Covid-19, my work performance has decreased, compared to the pre-Covid business as usual:

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly disagree

Q5. Changes in my company's policies, strategies, plans, procedures and practices introduced due to COVID-19 negatively affected safety onboard ships:

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly disagree

Q6. During Covid-19, I was obliged to deviate from safety and operating standards/procedures , compared to the pre-Covid business as usual:

1. Strongly agree
2. Agree
3. Neutral
4. Disagree
5. Strongly disagree

Q7. During Covid-19, compliance of the following safety training, drills, exercises, and meetings was maintained onboard my ship:

	Never	Rarely	Sometimes	Often	Always	No answer
Fire drills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Abandonment drills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bridge emergencies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Familiarization on change of crew	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Safety meetings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Oil spill response drills	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q8. During Covid-19, remote options have effectively replaced the physical surveys, inspections and audits onboard my ship:

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

Q9. During Covid-19, incidents on board ships of our company fleet increased, compared to the pre-Covid business as usual:

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

Q10. The seafaring profession remains as much attractive for me as it was before Covid-19:

1. Strongly disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly agree

Survey Part B. Perceived challenges in various operations

Q11. Considering your experiences at seaports in Europe, could you please indicate the change in the level of challenges in undertaking the following operations during Covid-19, as compared to the pre-Covid business as usual:

	Significantly increased	Increased	Remained unchanged	Decreased	Significantly decreased	No answer
Challenge in cargo operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Challenge in onboard planned maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Challenge in bunkering operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Challenge in navigation at sea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Challenge in navigation in port and restricted waters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Challenge in mooring and anchoring operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Challenge in passenger embarkation and disembarkation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Challenge in pilotage operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Survey Part C. Perceived Support from the Maritime Stakeholders

Q12. Please indicate the level of support from your shipping company during Covid-19 for the following:

	Poor	Fair	Good	Very good	Excellent	No answer
Facilitation of crew change	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Supply of provisions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facilitation of medical assistance ashore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Permission for shore leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provision of onboard facilities (internet, entertainment, games, communication with relatives, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q13. Please indicate the level of support received at European seaports during Covid-19 for the following:

	Poor	Fair	Good	Very good	Excellent	No answer
Facilitation of crew change	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Accessing medical assistance ashore	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Permission for shore leave	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments/ Suggestions

Here, we would like to invite you to share any additional information or experiences that you think might be relevant to our research. Your input can be extremely helpful in providing a more complete understanding of the potential impact of COVID-19 on shipping safety.

Interview invitation

If you are willing to participate in a personal interview to share your seafaring experience during Covid-19 please provide your email or phone number. We will be happy to hear your experience.

Thank you for taking the time to complete our questionnaire. Your contribution is greatly appreciated and will be instrumental in helping us gain valuable insights for our study.

Questionnaire for the impact of the safety issues

Dear Participant,

Thank you for your participation in the questionnaire conducted by the World Maritime University for the European Maritime Safety Agency. As a result of a year-long study entitled, "Study to detect potential COVID-19-related safety issues and emerging risks contributing to marine casualties and incidents", a set of potential safety issues and emerging risks to the maritime sector post-COVID-19 have been identified. We kindly request your input as a maritime expert in a short survey regarding the impact of the identified safety issues and emerging risks on different clusters of ships.

The survey includes one question, where you are asked to provide your valuable insights about the impact of the safety issues and emerging risks based on the recent ship type you have served on board. It would take less than 10 minutes to answer the question.

This research has been reviewed and approved by the World Maritime University Research Ethics Committee. If you have any additional questions or concerns about this project, please contact:

Dr. Anish Hebbar
Principal Investigator EMSA-Covid-19 project
Assistant Professor (Maritime Safety)
World Maritime University
E-mail: ah@wmu.se

Please see the Consent Form and provide consent.

1. I AGREE to participate in this study and provide my feedback based on my professional maritime experience.
2. I DO NOT AGREE to participate in this study.

Participant's background information

My sailing/shore-based experience relates to (type of ship):

1. Dry cargo ship
2. Tanker ship
3. Container ship
4. Passenger ship
5. Fishing vessel
6. Other _____

Assessment of the impact of the relevant safety issue and emerging risk

Please provide your assessment of the impact of the relevant safety issue and emerging risk pertaining to the ship type you have recently worked on board.

Scale Linguistic explanation

- 10- 12 (Very high): The safety issue may cause major operational disruptions, significant safety concerns
7-9 (High): The safety issue may cause noticeable disruptions in operations, considerable safety concerns
4-6 (Medium): The safety issue may cause some operational inefficiencies, moderate safety concerns
1-3 (Low): The safety issue may cause minor operational impacts, few safety-concerns

Safety Issue	Scale
SI1 - Behaviour and attitude change: COVID-19 may have affected seafarers' behaviour and attitudes due to prolonged contracts and restricted routines, potentially impacting maritime safety.	Scale 1 to 12
SI2 - Differential seafarers' transit travel rights: Different international travel rights for seafarers may impact crew changes and overall welfare.	Scale 1 to 12
SI3 - Unharmonized regulatory landscape: Inconsistent regulations during COVID-19, affecting seafarer mobility and port operations, may cause safety and operational challenges.	Scale 1 to 12
SI4 - Changing risk perception: COVID-19 may have altered the way seafarers understand and interpret the risk, affecting, accordingly, their safety judgments and awareness.	Scale 1 to 12
SI5 - Delayed maintenance: Pandemic disruptions may have affected ship maintenance schedules, impacting safety.	Scale 1 to 12
SI6 - Uncharted complex risk landscape: Post-COVID-19 changes in the maritime may require a review of risks due to new regulations, technologies and new ways of operations.	Scale 1 to 12
SI7 - Cyber vulnerabilities: Increased digital reliance post-COVID-19 may raise cybersecurity concerns, affecting vessel operations and entire fleets.	Scale 1 to 12
SI8 - Stress and fatigue: Increased stress and fatigue post-COVID-19 may impact seafarers' decision-making and safety.	Scale 1 to 12
SI9 - Erosion of seafarers' trust: Reduced seafarer trust, due to for example uncertainties, may hinder communication with their companies, affecting safety compliance.	Scale 1 to 12
SI10 - Timely risk communication: Timely communication of emerging risks empowers seafarers, companies, and regulators to understand, prepare for, and mitigate potential hazards, fostering transparent prevention and enhancing maritime safety.	Scale 1 to 12
SI11 - Decrease in collective years of experience: Reduced collective seafarer experience onboard, due to the departure of experienced individuals, may have consequences for maritime safety and efficiency.	Scale 1 to 12
SI12 - Maintenance of safety culture: In the wake of the pandemic, the safety culture may have been undermined, potentially affecting the overall maritime safety.	Scale 1 to 12
SI13 - Restructured supply chain: Post-COVID-19 supply chain changes may affect the availability of essential ship resources, impacting safety.	Scale 1 to 12
SI14 - Impact on teamwork: Altered schedules and remote work disrupt teamwork, and may pose challenges in coordination.	Scale 1 to 12
SI15 - Challenges in resilience testing: Proactively assessing resilience is crucial, rather than waiting for another crisis.	Scale 1 to 12
SI16 - Maintenance of skills and competency: Reduced in-person training and activity may degrade maritime professionals' skills and knowledge, impacting safety.	Scale 1 to 12
SI17 - Resource constraints: Post-COVID-19 resource shortages, especially for smaller companies, may impact maintenance and safety investment and compliance.	Scale 1 to 12
SI18 - Lost opportunity of knowledge transfer: The exit of experienced seafarers risks a knowledge gap for newer seafarers, losing invaluable expertise.	Scale 1 to 12

Appendix C Statistics from the respondents/ respondent demographics

The process of collecting data by interviews started on 24 October 2022 and ended on 1 March 2023, while the survey questionnaire was launched on 21 February 2023 and closed on 31 August 2023. And the focus group workshop has been conducted in the World Maritime University on 18 August 2023. The details of the composition of the participants presented below

Interviews

The total number of interviewed seafarers was 24, with an approximate average of experience of 15 years in maritime. The characteristics of the interviewees profile of seafarers are presented in figures 2, 3 and 4. The total number of interviewed DPA in the study was 20, with an approximate average of experience of 23 years in maritime. The characteristics of the interviewees profile are presented in figures 5 and 6. The total number of interviewed technical managers/ superintendents in the study is 20, with an approximate average of experience of 25 years in maritime. The characteristics of the interviewees profile are presented in figures 7 and 8. The total number of interviewed human resources managers is 21, with an approximate average of experience of 18 years in maritime. The characteristics of the interviewees profile are presented in figures 9 and 10. The total number of interviewed fishing industry professional was 15, with an approximate average of experience of 25 years in the fishing industry figure 11.

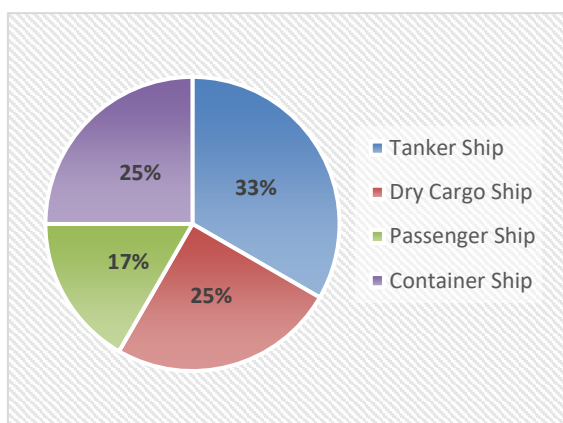


Figure 2: Distribution of interviewed seafarers by type of ships

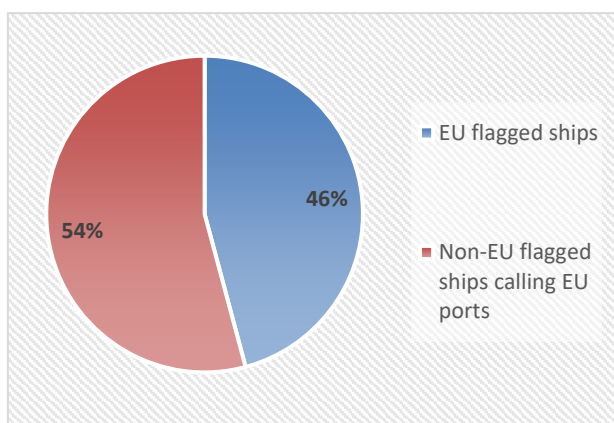


Figure 3: Distribution of interviewed seafarers between EU and Non-EU flagged ships

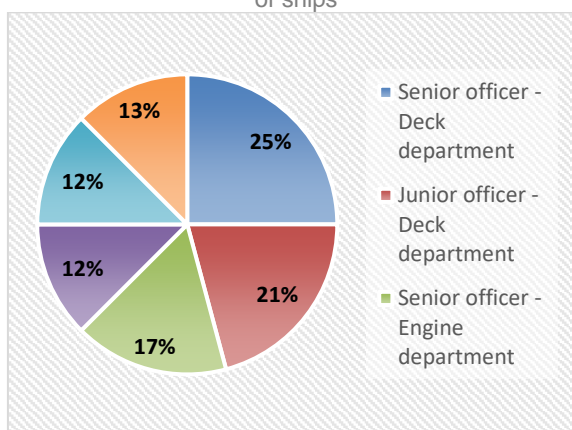


Figure 4: Distribution of interviewed seafarers by their rank

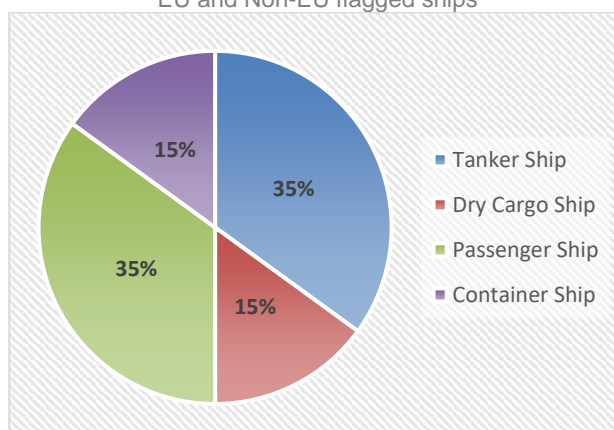


Figure 5: Distribution of interviewed DPAs by the type of ships

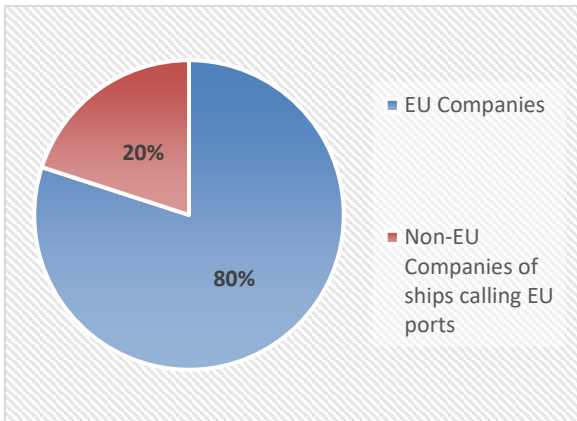


Figure 6: Distribution of interviewed DPAs between EU and Non-EU flagged ships

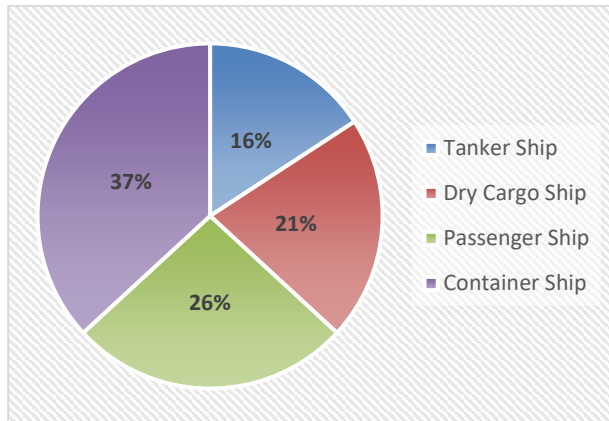


Figure 7: Distribution of interviewed technical superintendents by type of ships

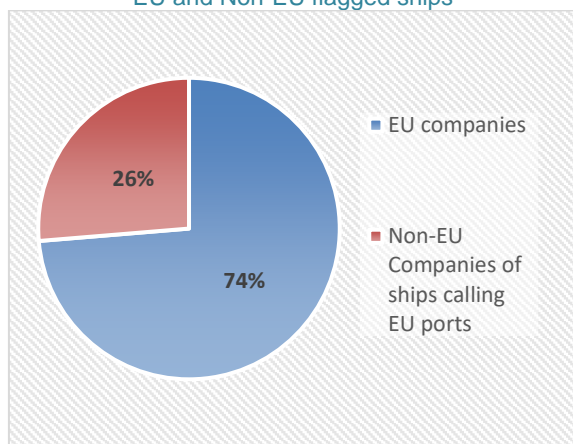


Figure 8: Distribution of interviewed technical superintendents between EU and Non-EU flagged ships

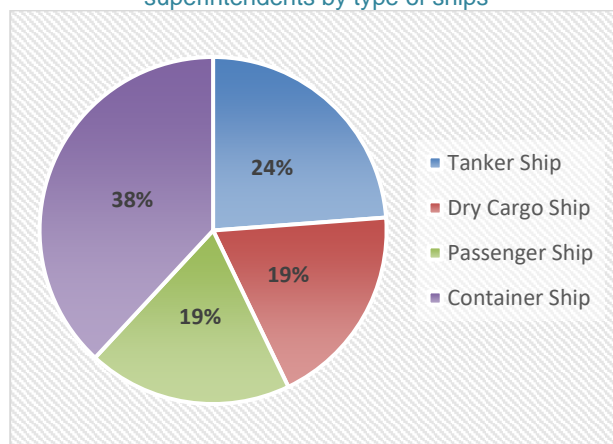


Figure 9: Distribution of interviewed human resources managers by type of ships

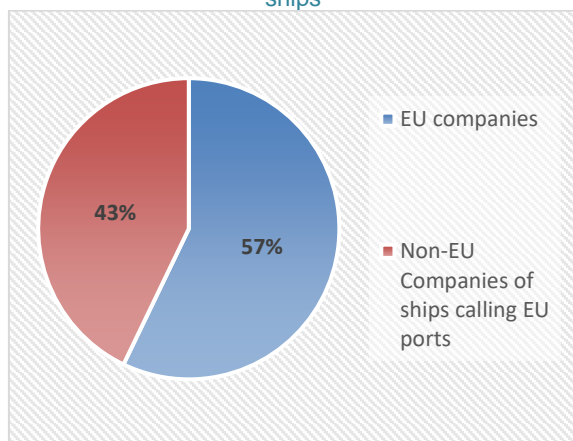


Figure 10: Distribution of interviewed human resources managers between EU and Non-EU flagged ships

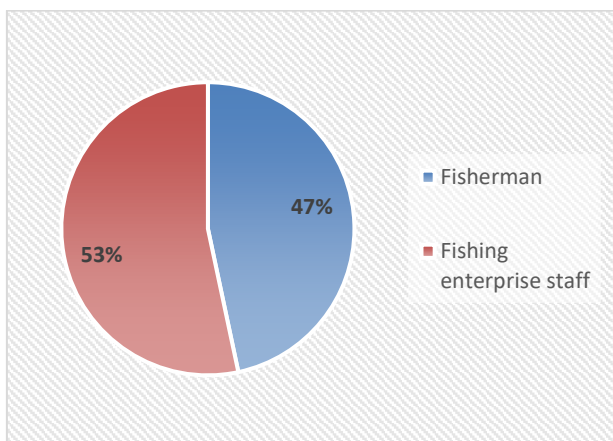


Figure 11: Distribution of interviewed fishing industry representatives by role

Questionnaire survey

The total number of completed survey questionnaire was 370, with more than 65% of the participants having more than 15 years of experience in seafaring. The demographics of the questionnaire participants including gender, type of ship, rank and sailed on EU and non-EU flagged ships calling EU ports are presented in figures 12-15.

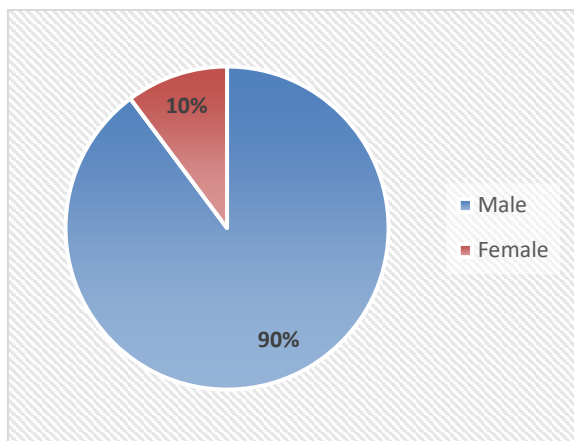


Figure 12: Distribution of questionnaire participants by gender

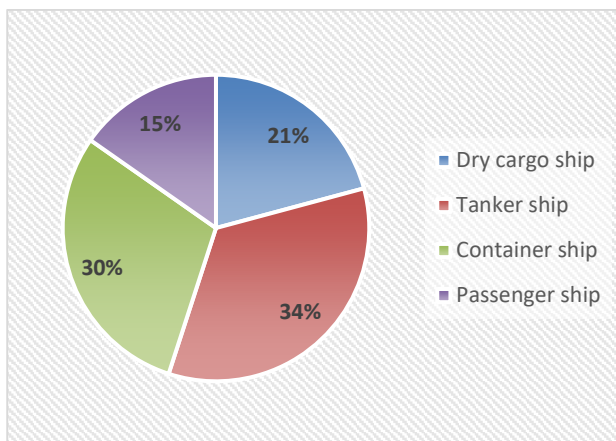


Figure 13: Distribution of questionnaire participants by type of ships

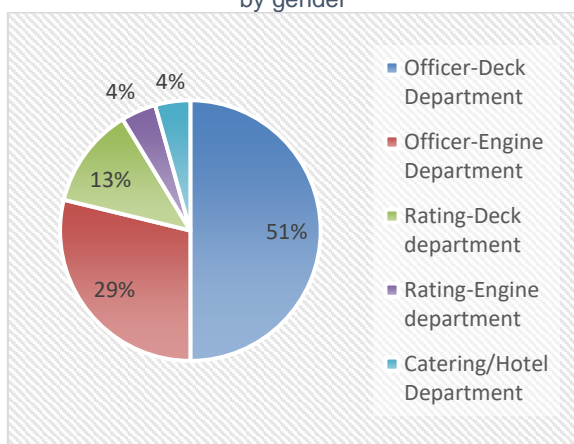


Figure 14: Distribution of questionnaire participants by rank

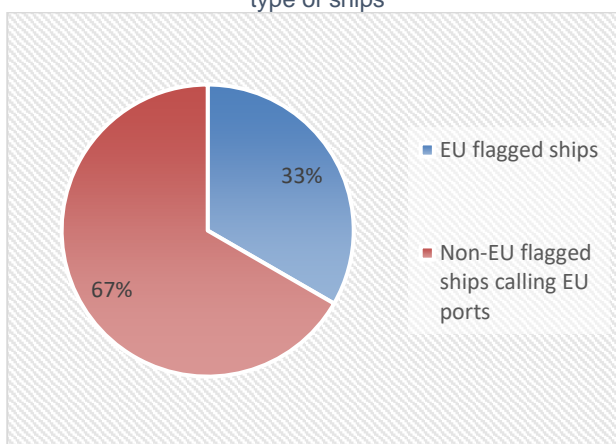


Figure 15: Distribution of questionnaire participants between EU and No-EU flagged ships

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