POTENTIAL COVID-19 RELATED MARITIME SAFETY ISSUES AND EMERGING RISKS

SYNTHESIS REPORT

EMSA

About this study:

This report was commissioned by the European Maritime Safety Agency (EMSA) under framework contract EMSA/OP/08/2022

Authors:

Recommended citation:

Legal notice:

Copyright notice[1]:

---

[1] The copyright of EMSA is compatible with the CC BY 4.0 license.

Synthesis report

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 |
| --- |
| ▪ 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
▪ Operations in the realm of the ship
o 11 types of operations
o 87 identified baseline indicators
▪ Operations in the realm of the company
o 5 types of operations
o 37 identified baseline indicators
▪ Operations requiring collaborative effort
o 7 types of operations
o 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.

Influence diagram of detected safety issues and emerging risks
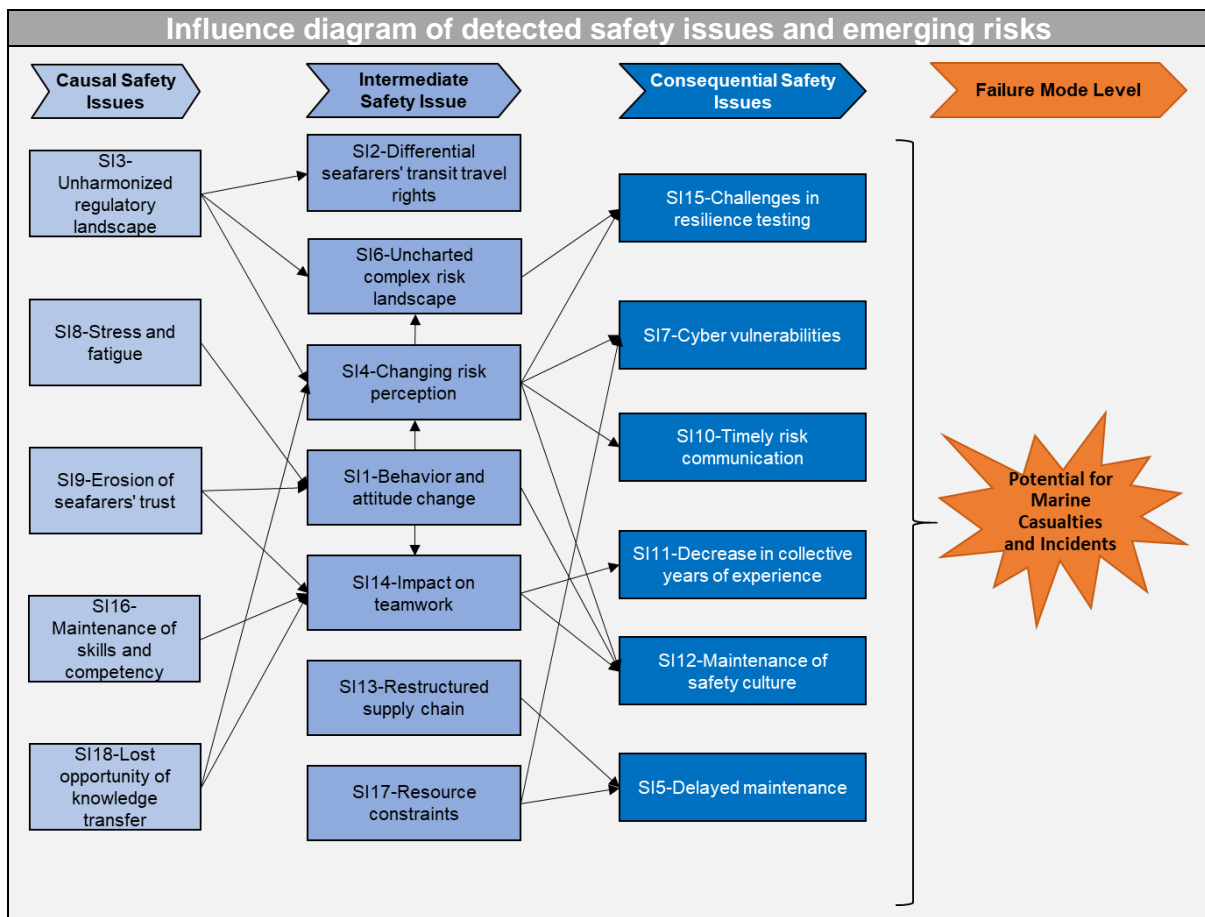
By applying Rasmussen's risk management model—a well-known framework in the literature—the study categorized the safety issues across three distinct levels: organizational, control, and individual. This categorization aimed to facilitate the exploration of nuanced interventions by the relevant maritime 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.

Rasmussen's framework of detected safety issues and emerging risks
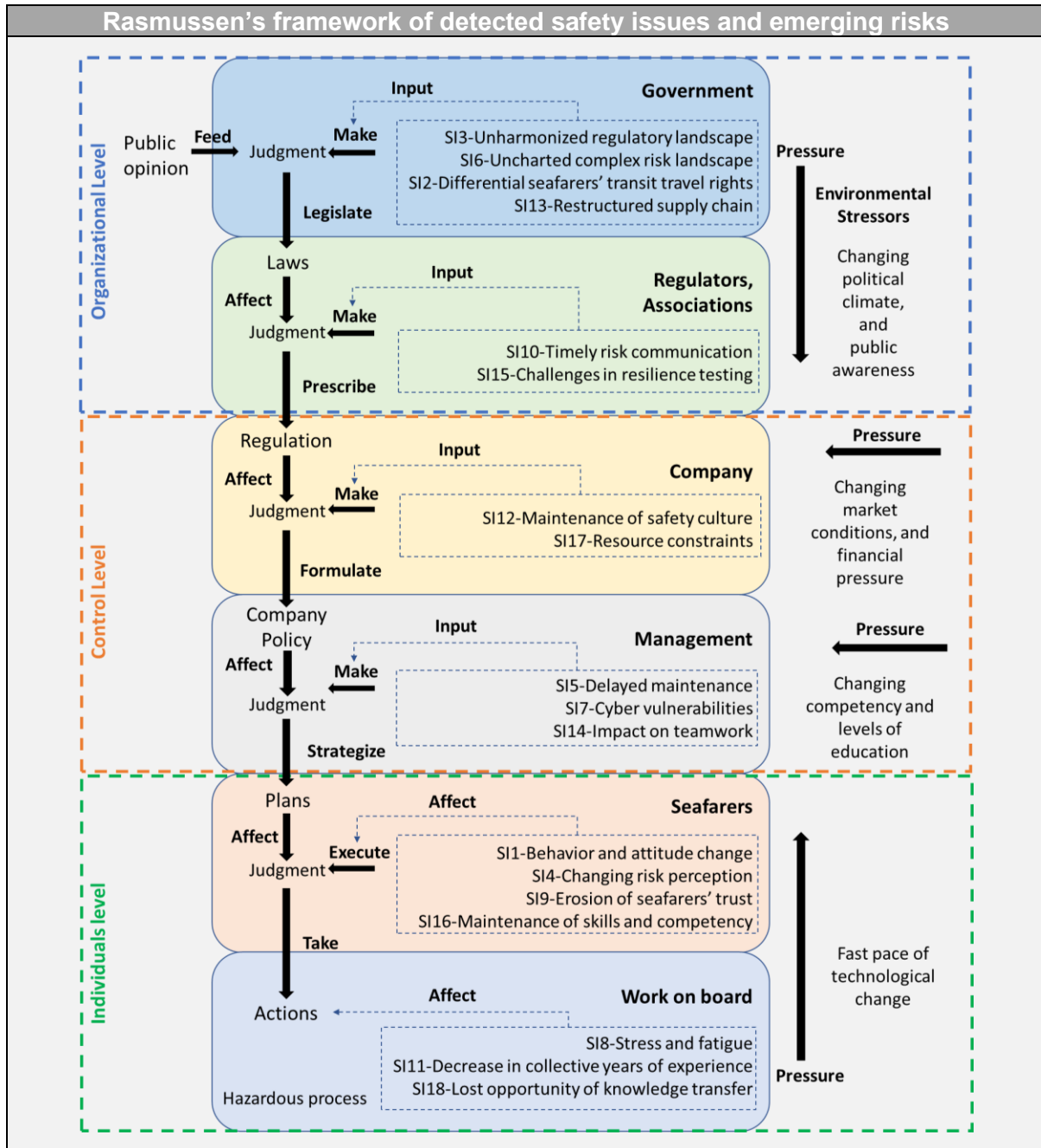
The temporal assessment of the identified safety issues revealed that while some were transitory – such as behaviour and attitude changes, unharmonized regulatory landscape, differential seafarers' transit travel rights and changing risk perception – and effectively attenuated by the industry's adaptive 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 *Significance: very high* *Transience: short to mid-term*	full and urgent attention and urgent resources	▪ SI1-Behavior and attitude change ▪ SI2-Differential seafarers' transit travel rights

Category 2 *Significance: high* *Transience: short to mid-term*	high attention and immediate resources	▪ 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
Category 3 *Significance: high* *Transience: persistent*	high investment and high, sustained attention due to complex nature of risk	▪ SI6-Uncharted complex risk landscape ▪ SI7-Cyber vulnerabilities
Uncategorized *Significance: moderate to low* *Transience: persistent*	may be addressed as deemed fit with no specific timeframe	▪ 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**
SI1-Behaviour and attitude change	▪ 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	▪ 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
SI3-Unharmonized regulatory landscape	▪ 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	▪ Discrepancies in safety reporting such as near miss reporting ▪ Increase in reported safety and operational protocol variabilities

SI5-Delayed maintenance	- 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	Rapid involvement of technological adaptations such as new fuels, digitalization, autonomous vessels, and other precursors can be specific to the operations
SI7-Cyber vulnerabilities	- 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	- 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	- 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	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	- High turnover rates, low retention rates - Lower average years of experience in crew
SI12-Maintenance of safety culture	- Increase in reported safety and operational protocol variabilities - Negative feedback from safety culture surveys
SI13-Restructured supply chain	- 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	- 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	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	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)	▪ 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	▪ 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
▪ Supply chain disruptions ▪ Economic impact ▪ Consumer behaviour ▪ Small-scale fisheries ▪ Government and policy responses ▪ Adaptation and resilience strategies ▪ Employment challenges	▪ 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
▪ 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**
▪ 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 communication

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	▪ Importance of flexibility and robust planning of maritime operations ▪ Strategic operational adjustments to respond global lockdowns
Preparedness and effective communication	▪ 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
▪ Stakeholder collaboration	▪ Pivotal role of seamless coordination across stakeholders ▪ Need for common understanding and unified actions in emergencies
▪ Need for global harmonization of regulations	▪ Urgency for cohesive regulatory standards worldwide ▪ Benefits of a harmonized approach to Places of Refuge for health crises and other emergencies
▪ Acknowledgement of seafarers, their mental health and well-being	▪ Critical importance of recognizing seafarers' contributions ▪ Necessity for holistic well-being measures and sustained support
▪ Technological leverage	▪ 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.
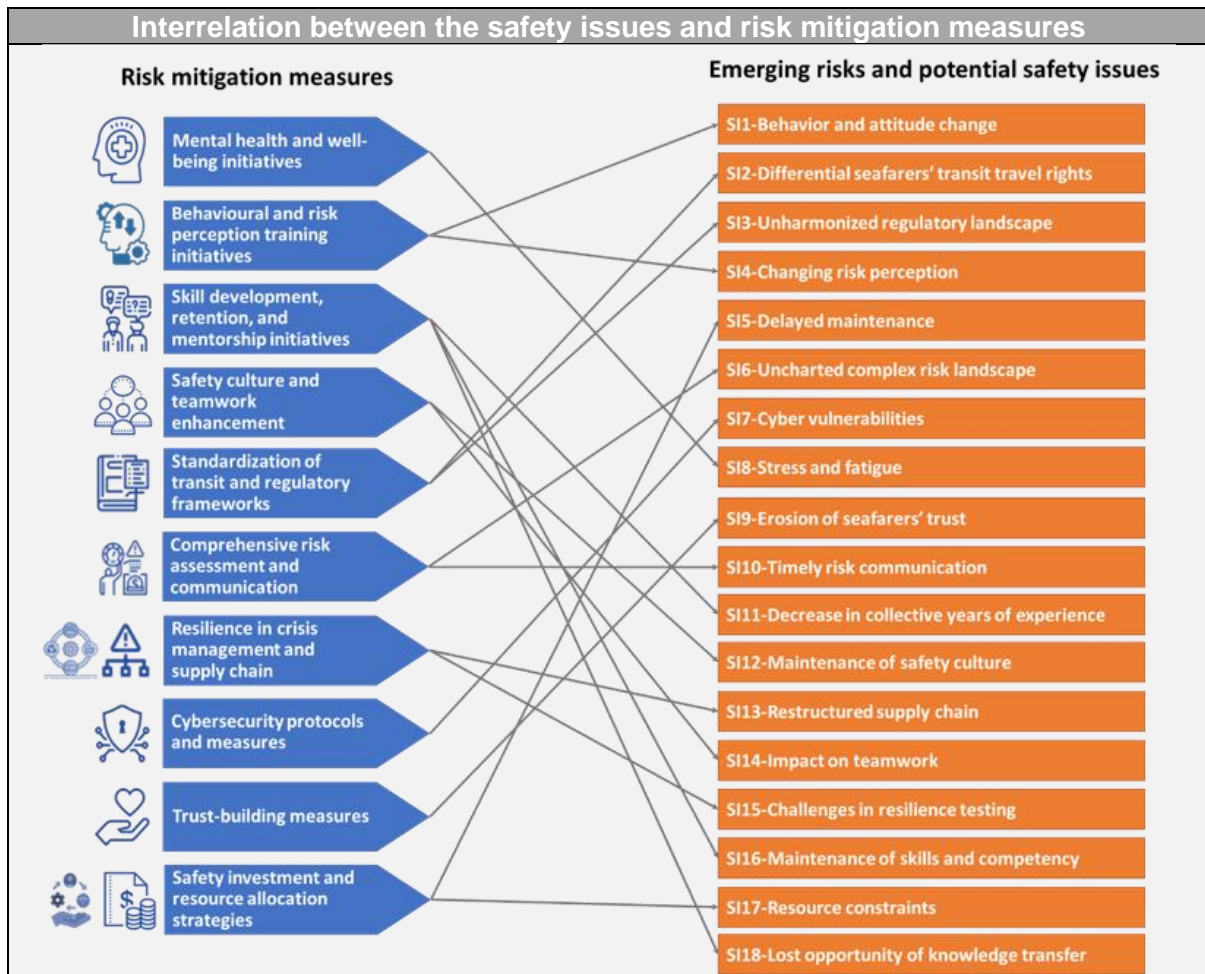
The study's findings further underscore the indispensable role of adaptability, preparedness, and effective communication within the maritime sector. The rapid shift to digital documentation and remote management of maritime operations points towards a future where efficiency and resilience are closely 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	▪ 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	▪ 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**	▪ 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	▪ Diversify supplier networks and foster strategic partnerships ▪ Simulate crisis scenarios to refine response strategies
Individuals level	**Crew welfare associations and seafarer support organizations**	▪ 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	▪ 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 casualties[2].

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:

  o **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.

  o **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.

  o **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.