THE MASS HUMAN ELEMENT –

COLLATING SEAFARERS' VOICES: PERSPECTIVES AND EXPECTATIONS

KMI KOREA MARITIME INSTITUTE
INTERNATIONAL TRANSPORT WORKERS' FEDERATION
KIMFT Korea Institute of Maritime and Fisheries Technology

President Dr. Jong-Deog Kim
Korea Maritime Institute

We sincerely expect that this report will contribute comprehensively to the development of the human-centered approach in shipping. This report will support the maritime mobility industry in the era of Artificial Intelligence (AI) with the necessary regulatory development for seafarers who will be affected greatly by the introduction and implementation of Maritime Autonomous Surface Ships (MASS).

Chair of Seafarers' Section, Mr David Heindel
International Transport Workers' Federation

The recognition for contributing to 90% of the world trade, and the blame for 90% of the accidents and incidents on human error put seafarers in an unenviable position. 'Out of sight', and 'unsung heroes'; seafarers have ironic titles. I commend this project for its courageous and honest projections of seafarers' voices. I strongly urge MASS regulatory developers to consider the expectations stated in this report and not to shy away from addressing the identified existing challenges. Give seafarers a positive and inclusive trajectory in the industry's future.

President Min-Jong Kim
Korea Institute of Maritime Fisheries and Technology

This report, which highlights the expectations, insights, and challenges of adopting Maritime Autonomous Surface Ships through the voices of seafarers who are on the front lines of maritime transportation, is invaluable at a time when legal regulations for MASS operations are being developed, and I hope that, it will contribute to securing the safe operation of MASS by enhancing the human element encompassing the seafarers.

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FOREWORD

The maritime industry of today has been shaped in large parts by the technological developments of the three previous industrial revolutions over the last two and a half centuries. Presently, Industry 4.0 finds its reflection in the industry with ever increasing introduction and integration of novel technologies leading to the advent of 'Maritime Autonomous Surface Ships (MASS)'. Since the introduction of the term, 'MASS' in the international maritime regulatory domain, efforts have increasingly been made to escalate the integration of technological advancements across diverse sectors of the industry to enhance the safety, security, efficiency, and environmental consciousness.

Over time, perspectives and efforts have evolved from a focus on technology development to other sectors of the maritime industry to streamline this paradigm shift to MASS. Seafarers are integral to the maritime industry; they are the key human element of shipping that contributes nearly 90% to the world trade. The regulations and policies around this paradigm shift to future shipping could capitalise on the years of knowledge, competences, and experience of the maritime workforce.

Taking the input of seafarers on current ongoing developments in the maritime industry has been considered sensitive and political but is critical at this juncture as they are one of the key maritime stakeholders. Along these lines the project partners collaborated to initiate conveying the voices of seafarers in the development of the MASS international regulatory environment. This would facilitate an understanding of the necessities to be considered in its framework and seek appropriate resolutions where required.

The project partners would like to extend their heartfelt gratitude to the research participants across diverse maritime organisations who graciously gave their time to the project. Their magnanimity and openness are a true reflection of their courage.

The project partners commend this initiative and anticipate further collaborations involving diverse stakeholders working together in making the maritime industry safer, secure, efficient, and more environmentally sound.

PROJECT PARTNERS

Korea Maritime Institute (KMI)

KMI KOREA MARITIME INSTITUTE

For over three decades since its establishment in 1984, KMI has been committed to research for the development of shipping, ports, marine, fisheries and maritime Industries, becoming a specialized research institute in these domains. KMI concentrates on conducting beneficial policy research. To achieve this, KMI carries out research on most imperative and practical spheres expected in these aforementioned sectors.

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International Transport Workers' Federation (ITF)

itf International Transport Workers' Federation

The International Transport Workers' Federation (ITF) is a democratic, affiliate-led federation recognised as the world's leading transport authority. ITF fights passionately to improve working lives, connecting more than 700 affiliated trade unions from 153 countries that may otherwise be isolated and helping their members to secure rights, equality, and justice. ITF is the voice for nearly 20 million working men and women across the world.

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Korea Institute of Maritime and Fisheries Technology (KIMFT)

KIMFT Korea Institute of Maritime and Fisheries Technology

Since its establishment in 1965, Korea Institute of Maritime and Fisheries Technology (KIMFT) has played a leading role in the development of maritime and fisheries industries by educating, training, and developing more than one million maritime human resources (maritime technicians and crews). KIMFT strives to be a first-class global institute for educating and training competent human resources in maritime and fisheries industries.

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

AAWA	The Advanced Autonomous Waterborne Applications Initiative
AIS	Automatic Identification System
BIMCO	Baltic and International Maritime Council
COLREGs	Convention on the International Regulations for Preventing Collisions at Sea
ECDIS	Electronic Chart Display and Information System
ETF	European Transport Workers' Federation
FAL	Convention on Facilitation of International Maritime Traffic
GMDSS	The Global Maritime Distress and Safety System
IMarEST	Institute of Marine Engineering, Science and Technology
IFSMA	International Federation of Shipmasters' Associations
ILO	International Labour Organization
IMO	International Maritime Organization
ITF	International Transport Workers' Federation
ICS	International Chamber of Shipping
KASS	Korea Autonomous Surface Ship
KIMFT	Korea Institute of Maritime and Fisheries Technology
KMI	Korea Maritime Institute
MARPOL	International Convention for the Prevention of Pollution from Ships
MASS	Maritime Autonomous Surface Ships
MCA	Maritime and Coastguard Agency
MET	Maritime Education and Training
MLC	Maritime Labour Convention
MSC	IMO Maritime Safety Committee
MUNIN	Maritime Unmanned Navigation through Intelligence in Networks

OECD	Organisation for Economic Cooperation and Development
RCC	Rescue Coordination Centre
ROC	Remote Operations Centre
SMCP	Standard Marine Communication Phrases
SOLAS	Safety of Life at Sea
STC	ILO Special Tripartite Committee
STCW	International Convention and Code on Standards of Training, Certification and Watchkeeping
UNCTAD	United Nations Conference on Trade and Development
UNSDGs	United Nations Sustainable Development Goals
VTS	Vessel Traffic Service
WMU	World Maritime University

1. SEAFARERS, INTEGRAL TO MASS DEVELOPMENT

Industry 4.0 has penetrated all industries worldwide, and the maritime industry is no exemption to this development. Digitalisation, automation, and other technological advancements, as the main facets of Industry 4.0, are transforming all aspects of the maritime domain. The technological revolution is affecting ship construction and design, operations, and crewing. The autonomous and unmanned shipping levels introduced by the recent industrial revolution promise to enhance safety, security, and sustainability. Currently, the shipping industry which is responsible for 90% of the global trade is facing social, economic, technological, legal, and environmental challenges. The previous technical or operational solutions like building different sizes of ships have reached their limitation in solving these issues. Thus, the new Industry 4.0 technology, such as autonomous ships, was introduced to be a potential remedy for the shipping industry's challenges. While there is growing research about the design, classification, and technology of the autonomous ship, examining the role of seafarers is largely neglected as it is considered to be politically sensitive. This needs to be investigated by responsible stakeholders. This report aims to present a brief overview on the current situation and impact of future shipping on seafarers in relation to MASS development.

What is MASS?

The autonomous ship is no more a concept for the future – it is already here. Over the last decade, many countries have established autonomous ship feasibility by making prototypes that have been used for research, navy, economic activities, aquaculture, rescue, emergency response, and environmental protection purposes. Different projects like MUNIN, ReVolt, MEGURI, KASS, Yara Birkeland, AAWA have tested the feasibility and proved the benefits of autonomous ships. However, in the maritime domain, autonomous ship is a novel concept that challenges all segments of the maritime industry including construction and design, equipment, and systems, regulatory, and operations. Indeed, different authorities, technology providers, and classification societies proposed various definitions for autonomous ship. Although the definitions differ based on the interest of each party, they all point to the levels of autonomy and the role of the human as operators. Accordingly, the level of autonomy indicates the level of human involvement in the ship operation with the increase of the presence of intelligent machines. However, shipping is an international domain regulated by internationally accepted legislation; this report refers to the current International Maritime Organization (IMO) definition. IMO, the leading authority in the maritime industry, has aimed to deliver autonomous shipping safely, securely, and in an environmentally friendly manner to meet the expectations of stakeholders. The IMO Maritime Safety Committee (MSC) defines the Maritime Autonomous Surface Ship (MASS) as:

"A ship that operates at various levels independent of human interference".

This definition and terminology are used in accordance with the MSC.1/Circ.1638, as agreed for the purpose of the Regulatory Scoping Exercise on MASS by the MSC at its 100th session in 2018. Based on that the IMO proposed four degrees of autonomy that are depicted in figure 1:

Degree of Autonomy (Mode of Operations)		Descriptions
01	Ship with automated processes and decision supports by seafarer	Seafarers are on board and should operate and control shipboard systems and functions. Some operations may be automated and sometimes be unsupervised but with seafarers on board ready to take control.
02	Remotely controlled ship with seafarers on board	The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.
03	Remotely controlled ship without seafarers on board	The ship is controlled and operated from another location. There are no seafarers on board.
04	Fully autonomous ship	The operating system of the ship is able to make decisions and determine actions by itself.

Figure 1: IMO degrees of autonomy for MASS Regulatory Scoping Exercise
Source: IMO (MSC 100/20/Add.1)

According to the IMO degrees and modes of operations, the shipping industry currently is experiencing a transition from degree 1 to 2, with degrees 3 and 4 on the horizon. The IMO's degrees of autonomy highlights that the transition period is a gradual shift from traditional shipping to autonomous shipping. Each degree emphasises how the expansion of technologies will transform the role of the human from onboard ship to onshore/Remote Operations Centre (ROC) where a ship will be monitored and operated remotely. However, the maritime industry has easily associated the autonomous ships in connection with degree 4, the fully autonomous ships. This misperception diverts the attention of the industry to the challenges of autonomous shipping rather than its opportunities. It should be highlighted that there will be a lengthy transition period to reach the stage of fully autonomous shipping. This requires the maritime industry to plan the roadmap for the smooth shift and transition as some examples depicted in figure 2. This period will reshape the shipping industry and needs transformation in critical aspects of the industry besides its technological aspect.

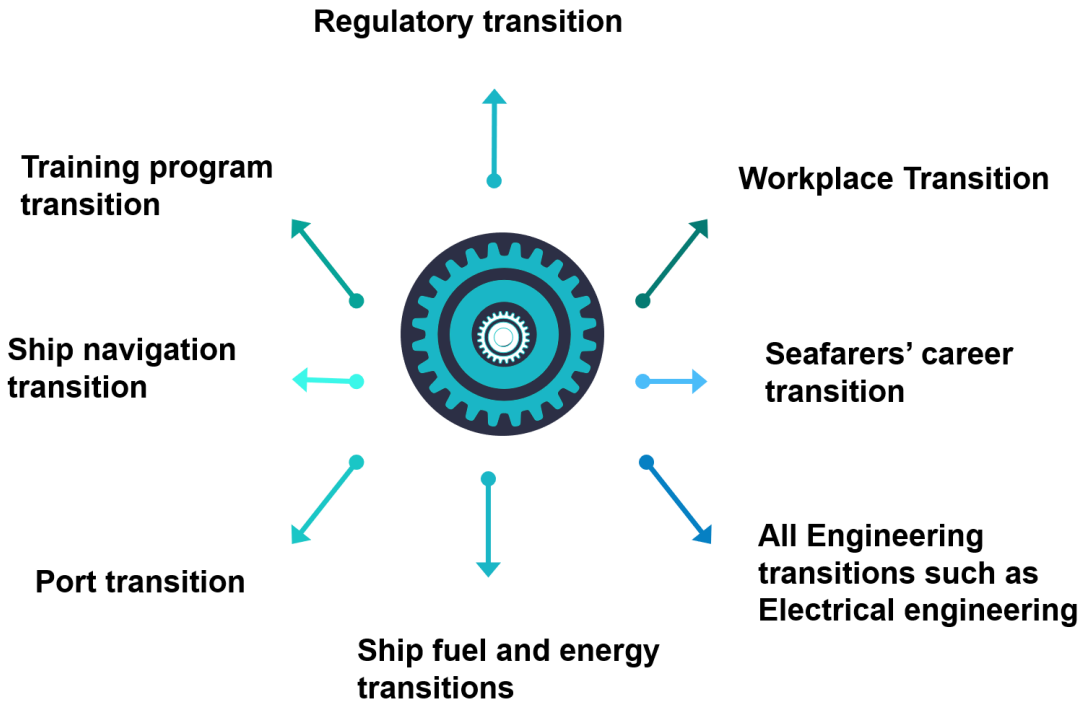


Figure 2: Examples of transitions due to MASS

Projections of seafarers' labour market

According to the forecast analysis of seafaring manpower demand, mentioned in studies conducted by the United Nations Conference on Trade and Development (UNCTAD), the International Chamber of Shipping (ICS), and the Baltic and International Maritime Council (BIMCO), seafarer demand can be explained by the number of vessels and the number of people on board per vessel. In other words, changes in maritime transport volume lead to changes in vessel capacity, which in turn changes the demand for crew members. As the globalised economy has positive maritime trade growth, seaborne goods volume is expected to continue to increase. Accordingly, the global merchant fleet is predicted to increase by 17.7% by 2025. Therefore, the global merchant fleet will increase by 0.66% per year for general cargo ships through 2025, while LNG will increase by 10% per year from 426 to 790 vessels, passenger ships at 1.04% per year, bulk carriers at 2.97% per year, and containerships at 1.97% per year. Crude oil carriers are predicted to show an overall annual growth rate of 1.86%, including a 2.84% increase. As shown in Table 1, the increase in demand for marine engineers due to the increase in the world merchant fleet is 91,000 (12%) between 2015 and 2020 and is expected to increase by 71,000 (8%) between 2020 and 2025. It has been predicted that 3,065 new sailors would be produced every year, and a total of 31,000 (4%) over 10 years, increasing by 15,500 every 5 years[1].

[1] ICS & BIMCO (2021). *ICS & BIMCO Seafarers Workforce Report / The Global Supply and Demand for Seafarers*.

Table 1- Forecasting of global demand, supply, and shortage of seafarers

Year	2015	2020	2025
Demand	790,500	881,500	952,500
Supply	774,000	789,500	805,000
Shortage (%)	-16,500 (2.1%)	-92,000 (11.7%)	-147,500 (18.3%)

Source*:* ICS & BIMCO Report (2021)[2]

However, as mentioned previously, autonomous ships are transforming maritime transport through the optimisation of operations and processes and efficient resource management, and the global market for autonomous ships is expected to grow at an average annual rate of 12.8% between 2017 and 2025[3]. In addition, the Acute Market Reports 2020 found that the demand for seafarers worldwide and domestic seafarers is high, even though the demand for seafarers should decrease with the advent of MASS. This is aimed at reducing numbers of some seafarers and autonomous navigation by 2025, but it is estimated that the flow of the seafarer labour market will be somewhat slower than the announced plan.

The World Maritime University (WMU) predicted the global demand for seafarers by 2040 due to the introduction of autonomous ships[4], and the simulation results of the study are shown in Fig 3.

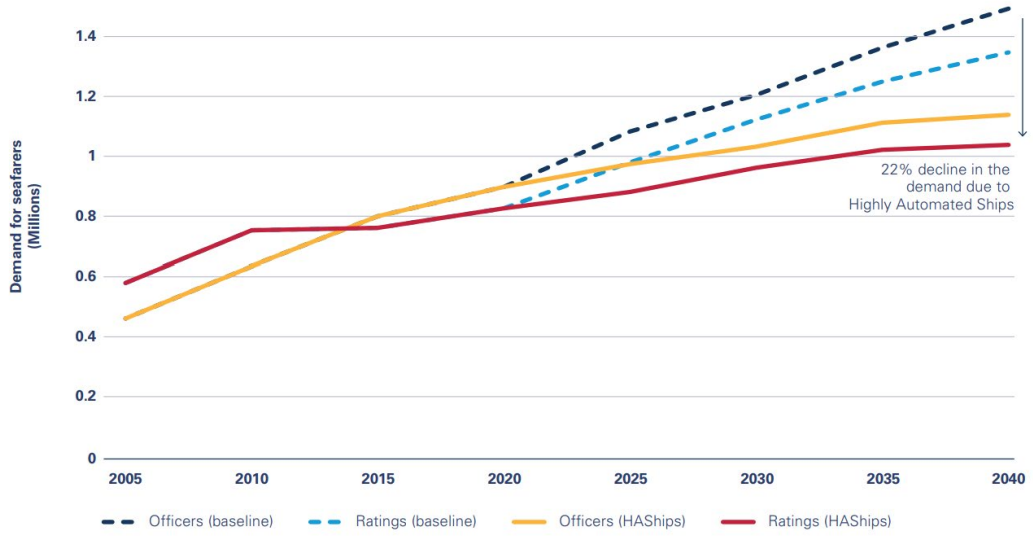


Figure 3: Simulations for the demand for seafarers
Source: WMU Report (2019)[5]

[2] ICS & BIMCO (2021). *ICS & BIMCO Seafarers Workforce Report / The Global Supply and Demand for Seafarers*.
[3] Acute Market Reports, Autonomous Ships Market Growth, Future Prospects & Competitive Analysis, 2017-2025. https://www.acutemarketreports.com/report/autonomous-ships-market
[4] WMU. (2019). *WMU Report: Transport 2040: Automation, Technology, Employment - The Future of Work*.
[5] WMU Report: Transport 2040. The Future of Work Historical data from ICS/BIMCO (2016); forecast used data from the start-up curves of Chapter 1 and UNCTAD maritime data; WMU forecast.

It shows that the introduction of highly automated ships will lead to a decrease in the global demand for seafarers by 2040 vis-à-vis the baseline projection based on current technology. The absolute number of seafarers is not expected to decrease by 2040 without the introduction of MASS. However, the growth rate is expected to attenuate as a consequence of the introduction of autonomous ships. The simulations in figure 3 show that the introduction of highly automated ships decreases the growth rate in the demand for seafarers, leading to a potential reduction of 22 % (figure 4, dashed line) in global demand for this category in comparison to the projected demand baseline (conventional ships).

Similar effects are observed for both officers and ratings. When accounting for the increase in the volume of seaborne trade projected for 2040 as forecast, the simulations show that its effects do not compensate for the overall reduction of labour demand (figure 4). Trade is expected to hamper the impact of automation on the demand for seafarers by 36 % (Figure 4, dashed line).

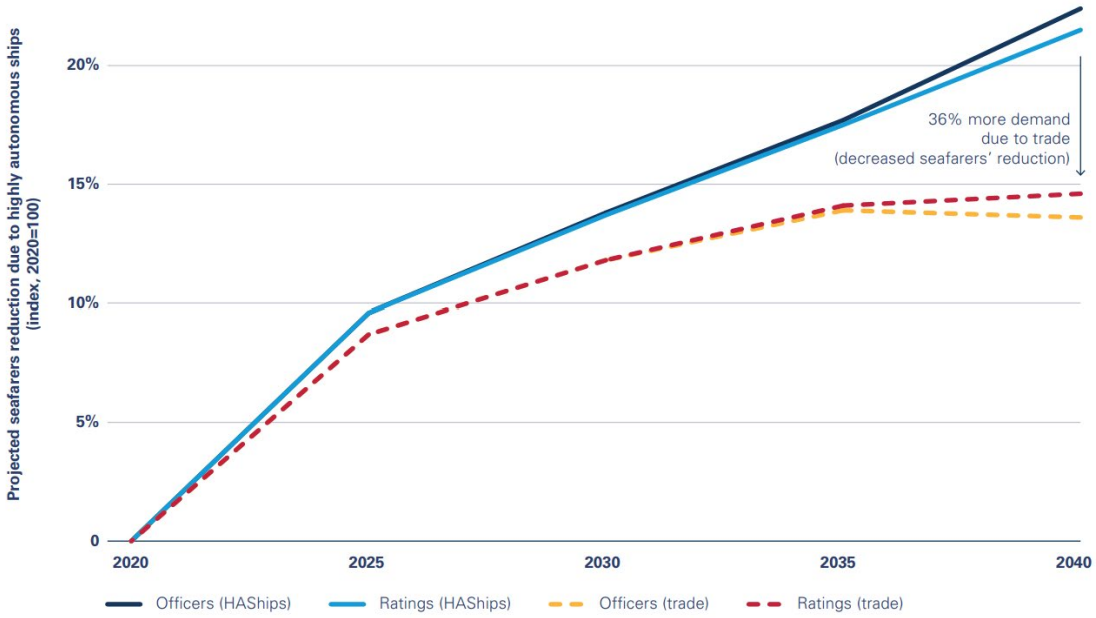


Figure 4: Projected reduction of the labour demand for seafarers
Source: WMU Report (2019)[6]

Despite the decline in the growth rate, it is essential to note that, for the period under analysis, all the simulations point towards growth in the demand for seafarers from 2020 to 2040. In absolute numbers, the number of seafarers required by 2040 is expected to be significantly higher than the current level. In some scenarios, the figure is almost double that of the approximately 1.6 million seafarers working today. However, what technology is expected to do is to slow down the increase in the number of seafarers needed to carry out global trade.

[6] WMU Report: Transport 2040. The Future of Work Historical data from ICS/BIMCO (2016); forecast used data from the start-up curves of Chapter 1 and UNCTAD maritime data; WMU forecast. Historical data from ICS/BIMCO (2016); forecast used data from the start-up curves of Chapter 1 and UNCTAD maritime data; WMU forecast.

As a result, the introduction of MASS can be seen as directly related to the employment and vocational training of seafarers according to automation. The labour projections highlight the potential of technological innovation/automation and how it impacts different skill groups in the maritime transport sector in different ways. Accordingly, the impact is not monolithic as alongside displacement and elimination, the growing use of technologies in the workplace can lead to the creation of more jobs[7].

Decarbonisation in relation to MASS development

In addition to seafarers' labour market trends, along with MASS, the demand for seafarers and job creation in the future can emerge for seafarers who require training and development in future alternative fuels and safe handling due to decarbonisation. Future seafarers require digital skills, including training on alternative fuels that must be used to achieve the 2050 net zero or zero emissions goal. In this regard, figure 5 is the result of DNV's analysis of the ability and required education of future seafarers. Decarbonisation will require a new set of skills that are given in figure 5.

- Uptake of alternative fuels includes safety challenges
- Digitalisation and automation will follow in the wake of alternative fuel technologies
- The added complexity points toward a need for "higher-skilled" seafarers

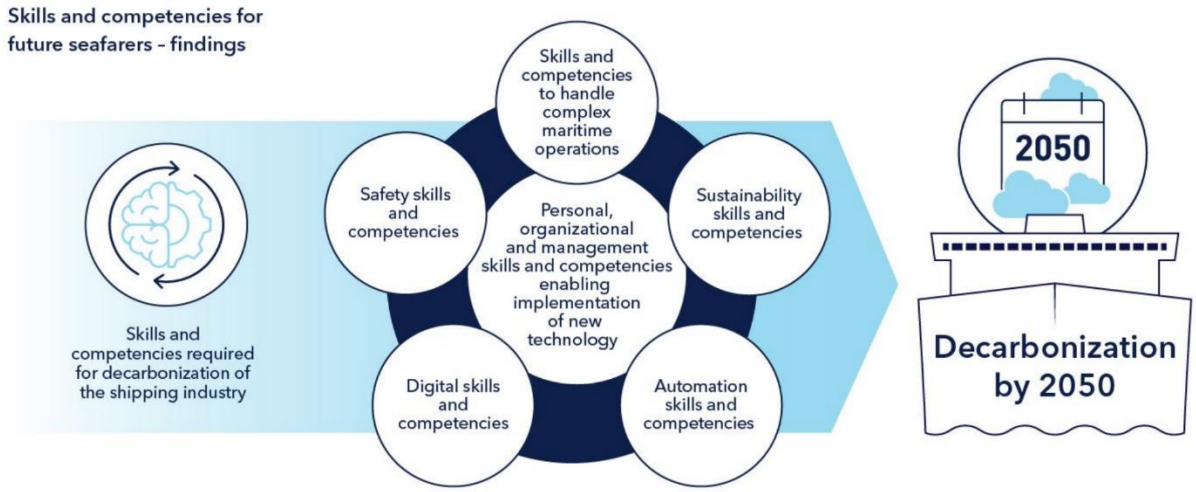


Figure 5: Skills and competencies for future seafarers
Source: DNV Report (2022)[8]

As a result, future seafarers living in the era of high-tech development of digitisation and decarbonisation, must recognise that new skills and capabilities are increasingly in demand. Various factors add complexity to ship operations, increasing the need for "higher-skilled" seafarers:

[7] WMU. (2019). *WMU Report: Transport 2040: Automation, Technology, Employment - The Future of Work*.
[8] DNV. (2022). *DNV Report: Insights into Seafarer Training and Skills Needed to Support a Decarbonised Shipping Industry*.

- Decarbonisation and sustainable shipping will require new sets of skills for seafarers in the years up to 2050 and beyond.
- Alternative fuels involve safety challenges (flammability, explosion risk, toxicity) requiring a safety-first approach by the industry and more advanced safety skills.
- Digitalised ship operations, automation and a growing focus on autonomous shipping call for enhanced familiarity with digital and automation technologies.

Crew members will need a combination of advanced personal, organisational, and management skills for the shipping industry to benefit from the potential of future technologies and handle more complex maritime operations competently. Ship operators should implement measures that ensure a sound safety culture in this time of transition – a time-consuming endeavour requiring close cooperation between managers and employees. The 'Safety Mindset' established on tankers and gas carriers should be adopted by shipowners and seafarers in other trades as well. Human Factor Engineering also addresses the general well-being of seafarers, workstation design and mental health, and a smart approach to fuel hazards helps avoid human error and incidents. Several research institutes, including DNV, emphasise Human, Organizational, and Technical elements in relation to safety (figure 6). The safety of maritime systems can best be understood from a system perspective that requires constructive interaction between three elements, which together create robust and resilient systems capable of continuous improvement. It is believed that this holistic approach is needed to address the safety challenges resulting from decarbonisation, digitalisation, and automation of maritime processes[9].

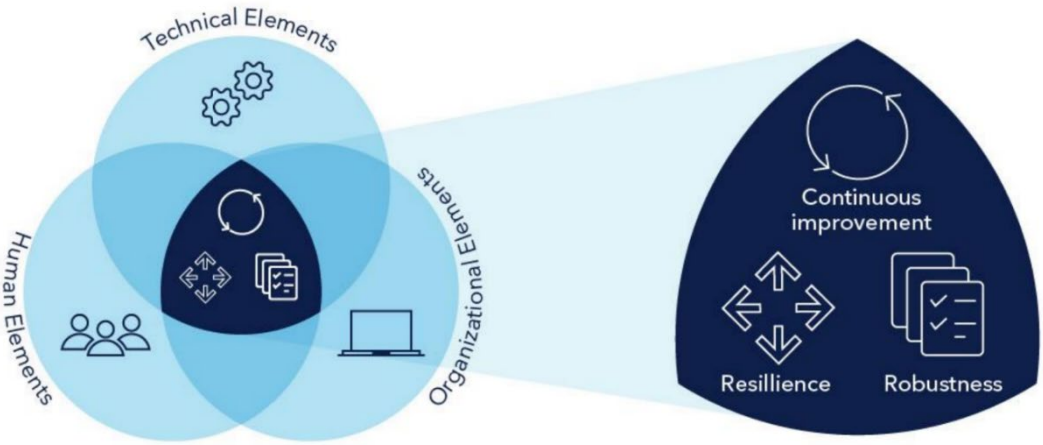


Figure 6: Interactions and properties of a safe maritime system
Source: DNV Report (2022)[9]

[9] DNV. (2022). *DNV Report: Insights into Seafarer Training and Skills Needed to Support a Decarbonised Shipping Industry*.

MASS as an Opportunity or a Challenge

As stated in the previous sections, a significant amount of research has predicted that the shipping industry is currently facing and will continue to face a substantial shortage of skilled seafarers in the near future. The maritime industry is already under the spotlight to reduce ship emissions and pollution to meet the current legislative requirements. Researchers and experts believe that Industry 4.0 and MASS can be and must be an opportunity to solve the current challenges and turn them into opportunities. Some of the potential benefits of MASS include the reduction of operation cost, reduction of ship emission aligned with green shipping, enhancement of ship safety and efficiency, promotion of eco-friendly operation, optimisation of logistics, and, more importantly, increasing the presence of the female workforce in the maritime industry, creating a more suitable and attractive workplace for seafarers as depicted in figure 7.

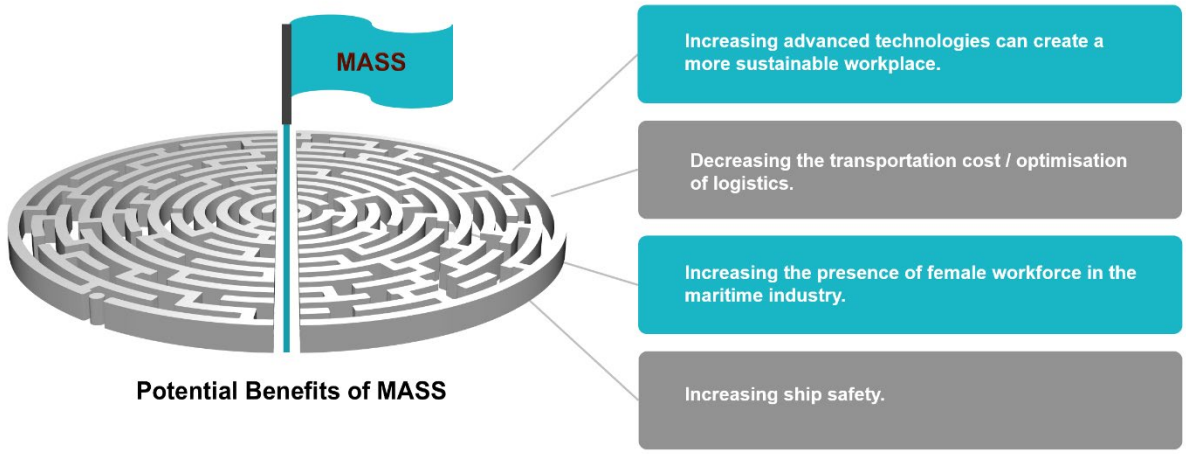


Figure 7: Potential benefits of MASS based on existing literature
Source: [1-3][10]

Although the future of MASS promises many opportunities for the maritime industry, it will also bring many challenges. One of the main challenges will be the changes in seafarers' roles, responsibilities, qualifications, certifications, designation, employment, and learning processes. As the main leading element of Industry 4.0, digitalisation and automation are progressing exponentially in the shipping industry. This is paving the way for a gradual shift from degree 1 to degree 2 of MASS. Indeed, the primary goal of Industry 4.0 implementation in the shipping industry is to enhance the efficiency of work processes onboard ships by supporting the seafarer's workload with advanced machines. Consequently, the competencies of seafarers in the technologically rich environment are expected to be redefined based on the new work requirements onboard ship and onshore/

10-1 Streng, M. and B. Kuipers, *Economic, social, and environmental impacts of autonomous shipping strategies*, in *Maritime Supply Chains*. 2020, Elsevier. p. 135-145.

10-2 Kretschmann, L., H.-C. Burmeister, and C. Jahn, *Analyzing the economic benefit of unmanned autonomous ships: An exploratory cost-comparison between an autonomous and a conventional bulk carrier*. Research in transportation business & management, 2017. 25: p. 76-86.

10-3 Narayanan, S.C., G.R. Emad, and J. Fei, Key factors impacting women seafarers' participation in the evolving workplace: A qualitative exploration. Marine Policy, 2023. 148: p. 105407.

Remote Operations Centre (ROC). Thus, the seafarers' roles and responsibilities in response to MASS development are changing dramatically because the new workplace requires seafarers who are able to continuously learn new skills as the existing technology matures or the new one emerges.

Seafarers' Response to MASS

Evidence of past experiences reveals how the shipping industry has relied on seafarers' knowledge and competencies. However, the emergence of technology such as the Global Maritime Distress and Safety System (GMDSS)and Electronic Chart Display and Information System (ECDIS) in the shipping industry has transformed the seafarers' expected competency in the workplace and redefined their roles and responsibilities. From a broader picture, the maritime industry is facing a powerful trigger, the Industry 4.0 and its digital technology revolution. This trigger will affect all aspects of the shipping industry and seeks to remake the seafarers and machine work division onboard ship and onshore/ ROC. Within this context, the workforce, as the primary resource of all industries, including the shipping industry, will face new challenges with the introduction of MASS. It is time for the shipping industry to consider how technological advancement through digitalisation and automation influences the current and future of maritime workforce. This can be a chance for the shipping industry to manage the challenges and turn them into opportunities. Thus, seafarers, as an inseparable element of the shipping industry, will catch up with the MASS development in a same pace. In this regard, the seafarers' position gradually shifts from onboard ship to onshore/ROC or even to the earlier design and testing stages during the transition period. Indeed, this transition could impact seafarers in unprecedented ways as it brings novel jobs that will result in changes in seafarers' training during their gradual movement from foreground to background. It is evident that automation leads to some job obsoletion onboard ship. However, new job opportunities with new requirements will emerge simultaneously. In this regard, seafarers certified through the current STCW requirements for the existing ship needs to receive the new training for reskilling and upskilling in accordance with the evolution of MASS. Concurrently, the IMO is expected to finetune standards and provisions under its purview by considering the importance of seafarers in the MASS development strategy.

On the other hand, most of the current research concentrates on autonomous technology like autonomous ship navigation system, propulsion and manoeuvring capability, collision avoidance, and cyber security. Even though the industry recognises the imperativeness of seafarers, there is a lack of research on the seafarers' challenges in response to future MASS operations. In this respect, there is a crucial necessity to fill this gap to assure industry's readiness for this transformation.

Importance of Stakeholders' Involvement in MASS

The rapid and significant developments of digitalisation and automation in the maritime industry aim to increase safety, efficiency, and sustainability, of shipping aligned with the United Nations Sustainable Development Goals for 2030. In contrast, the main focus of maritime authorities, organisations, and classification societies is the realisation of MASS and its technological feasibility. MASS requires a massive transformation of ship design,

port infrastructure, shipbuilding, business model, workforce competency and training models in addition to the evolution of technologies and regulations. Thus, the smooth and fluent implementation of MASS requires the involvement of various maritime stakeholders. All maritime stakeholders should have communication, collaboration, cooperation, and a multilateral understanding regarding the MASS development process like any other transitions in the maritime industry. On the other hand, all stakeholders should work individually but also collaboratively, adopt technological advancement in their systems, and develop a new integration model. Figure 8 illustrates some of the critical stakeholders in the MASS development process.

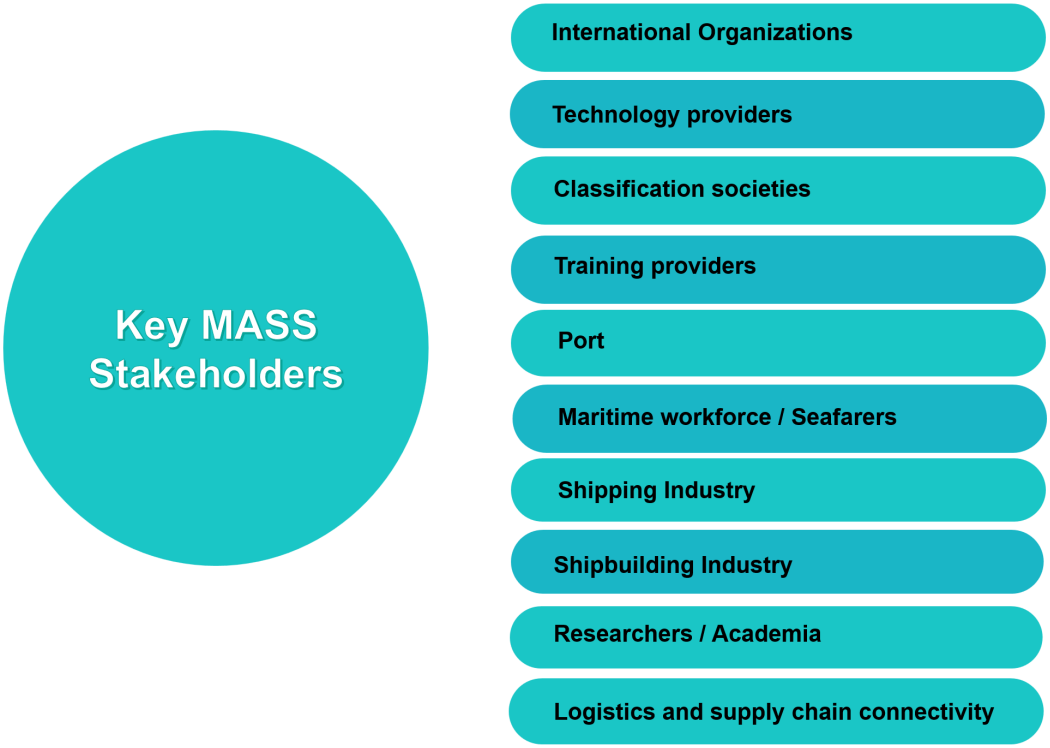


Figure 8: Diverse maritime stakeholders in the MASS development process
Source: Doctoral research on "Investigating Seafarer Training for Autonomous Shipping: Requirements and Challenges." (2020-2023)

There is a critical need to investigate how the role of seafarers will transform and how they should be trained to fulfil the requirement of the novel role.

The maritime industry, like other industries, is responsible for the safety, security, welfare and wellbeing of its workforce. There should be a synergy among all stakeholders for collaborating to balance the development of MASS alongside seafarers' evolution to face, adapt, and grow simultaneously. Therefore, it is critical to investigate the current position of seafarers in response to MASS and how they will be impacted over time by conducting further research.

The Way Forward

As highlighted, digitalisation and automation have penetrated the shipping industry in diverse ways to pave the way for the emergence of MASS. Consequently, the workplaces onboard the ship and onshore will evolve resulting in new roles, responsibilities, qualifications, certifications, and designations of the maritime workforce. Thus, the maritime industry needs to investigate how the seafarers should be best supported during the transition period. To fulfil this, the Korea Maritime Institute (KMI), in collaboration with International Transport Workers' Federation (ITF), and the Korea Institute of Maritime and Fisheries Technology (KIMFT), has conducted a research project on conveying seafarers' voices. This research fills the identified gaps and assists in identifying the seafarers' areas of expectations and needs regarding MASS to be part of another chapter of evolution in maritime history.

2. PROJECT RATIONALE

The project partners envisaged the MASS human element research project for illumining the diverse pressing issues and concerns of seafarers' organisations in connection with MASS regulatory development as a timely and crucial input for the IMO MSC 107th meeting in May 2023.

The available literature on MASS/autonomous ships highlights the preponderance of technical and engineering related papers. The limited focus on the Maritime Human Element in connection with MASS prompted the project partners to look deeply in this direction to support seafarers as one of the important stakeholders. Additionally, the discussions taking place at the IMO level primarily involve government representatives of member states. Therefore, in line with its principles of holistically supporting transport workers at international fora, the ITF, along with its project partners, undertook the MASS human element research project to lend a voice to the seafarers and bring their views and requirements at the forefront.

This project report fulfills the rationale for the study with its focus on seafarers as one of the crucial stakeholders in MASS discussions. The report summarises the views and agency of the seafarers' organisations on MASS; their involvement at the international and national level concerning MASS; their engagement with employers and other entities in furthering their interests in connection with MASS; their policies and strategies in connection with MASS; their address to the maritime stakeholders, and recommendations for the way forward. Additionally, the report highlights the current and future challenges facing seafarers and the issues to be considered in the development of the MASS regulatory instruments.

3. MASS IN LITERATURE

A literature search in the SCOPUS database with the keywords, 'Maritime Autonomous Surface Ships' yields 410 records. Literature on automation and automated systems in shipping began appearing in the early 2000s, however literature on MASS/autonomous ships increased exponentially in the last five years from 2018 onwards after the term gained currency. In 2017 the IMO had initiated the regulatory scoping exercise for MASS, the outcome of which has been completed in 2021[11]. Figure 9 below presents the documents pertaining to MASS/autonomous ships per year. A large percentage of this literature is technical in nature (see figures 10 and 11) with limited focus on the maritime human element.

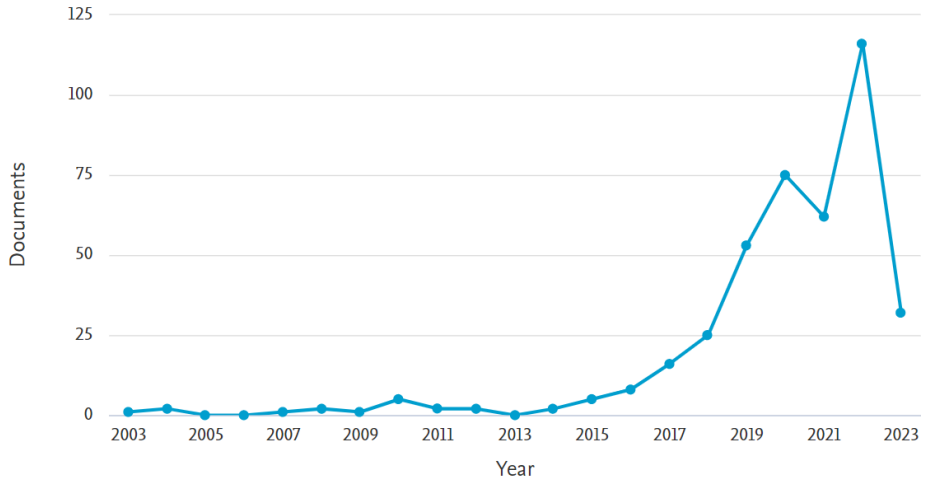


Figure 9: MASS/autonomous ship documents per year (2003 - March 2023)
Source: SCOPUS analytics

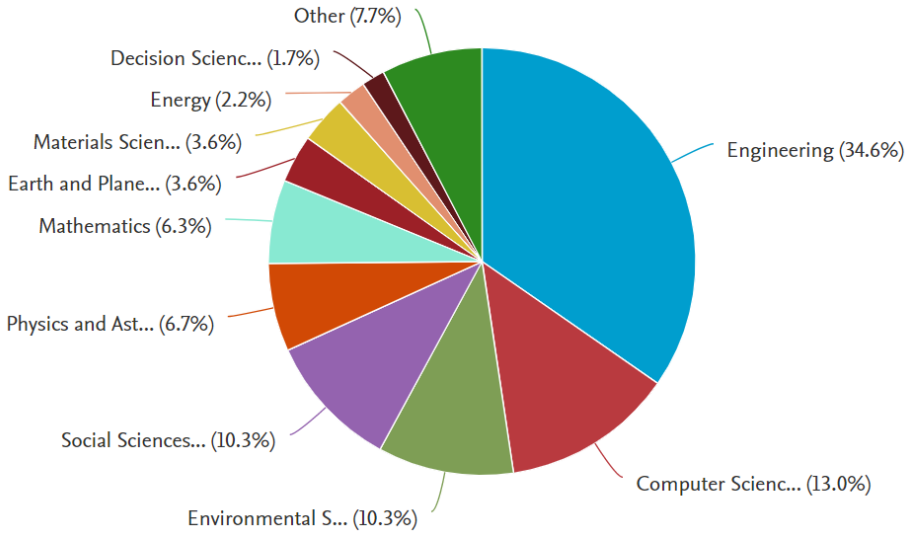


Figure 10: MASS/autonomous ship research papers according to subject area
Source: SCOPUS analytics

[11] IMO. (2021). *MSC.1/Circ. 1638 Outcome of the regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)*. London: IMO.

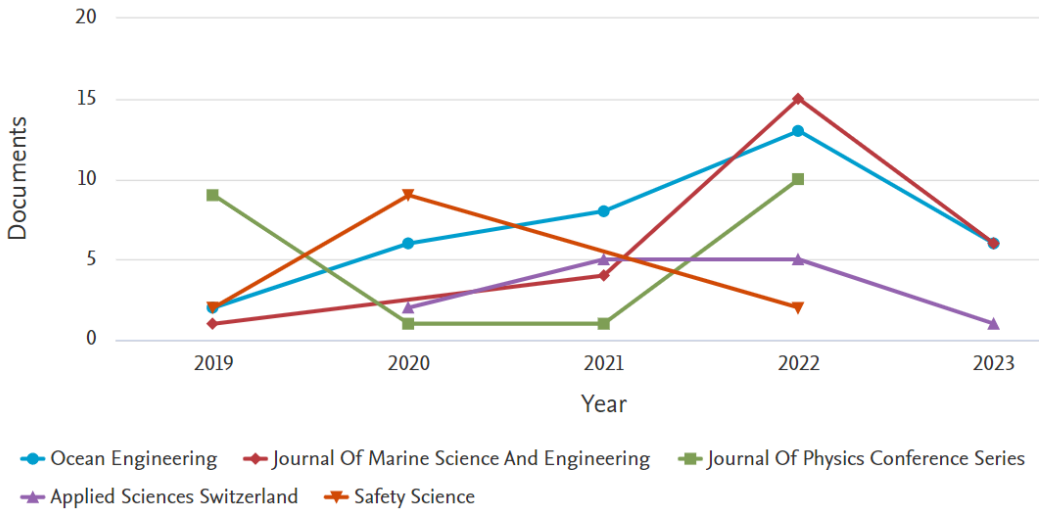


Figure 11: MASS/autonomous ship research papers per year by academic sources
Source: SCOPUS analytics

Figure 11 highlights the top five sources of literature on MASS/autonomous ships indicating the technical and engineering bent of the studies in this area. About 10% of the literature pertains to the discipline of social sciences. Within this a few studies address Maritime Education and Training (MET) – the challenges to MET and the identification of technical, non-technical, and leadership competencies in future shipping[12,13]. A few of studies have looked at the perspectives of stakeholders[14], including those of cadets[15,16]. Noteworthy is that most of these studies are quantitative in nature and have adopted a survey-based approach.

The ITF, KMI, and KIMFT MASS Human Element project adopted a holistic qualitative approach to comprehensively unpack the seafarers [17] expectations, needs, and engagement with MASS. This research supports the seafarers as one of the key stakeholder groups in MASS discussions that will shape the way forward. The development of MASS is closely aligned with discussions around decarbonisation,

[12] Kim, T. E., & Mallam, S. (2020). A Delphi-AHP study on STCW leadership competence in the age of autonomous maritime operations. *WMU Journal of Maritime Affairs*, 19(2), 163-181. doi:10.1007/s13437-020-00203-1
[13] Sharma, A., & Kim, T. (2021). Exploring technical and non-technical competencies of navigators for autonomous shipping. *Maritime Policy & Management*, 1-19. doi:10.1080/03088839.2021.1914874
[14] Theotokatos, G., Dantas, J. L. D., Polychronidi, G., Rentifi, G., & Colella, M. M. (2023). Autonomous shipping — an analysis of the maritime stakeholder perspectives. *WMU Journal of Maritime Affairs, 22*(1), 5-35. doi:10.1007/s13437-022-00290-2
[15] Jo, S., D'agostini, E., & Kang, J. (2020). From seafarers to e-farers: Maritime cadets' perceptions towards seafaring jobs in the industry 4.0. *Sustainability* 12(19), 1-18. doi:10.3390/su12198077
[16] Bogusławski, K., Gil, M., Nasur, J., & Wróbel, K. (2022). Implications of autonomous shipping for maritime education and training: the cadet's perspective. *Maritime Economics and Logistics, 24*(2), 327-343. doi:10.1057/s41278-022-00217-x
[17] It is encouraged to replace 'manning' with the gender-neutral nomenclature 'crewing.' However, International Maritime Organization (IMO) and International Labour Organization (ILO) mandatory legal instruments still contain 'manning' hence this project retains the term to align with the current international regulatory practice (as of April 2023)

alternate fuels, alternate engines, and the just transition towards environmental sustainability for all.[18]

The research on MASS has predominantly focussed on the technical aspects. There are gaps in the legal domain[19,20,21,22] as the IMO's regulatory scoping exercise was recently completed in 2021 and the MASS code is currently under development. The roles and responsibilities, qualifications, competences, certification, designation, and employment of the seafarers are unclear at this juncture, and broader conceptualisation of operators in future shipping that goes beyond the gamut of the Remote Operations Centre (ROC) is needed.

[18]International Labour Organization. (2015). *Guidelines for a just transition towards environmentally sustainable economies and societies for all.* Geneva: ILO.
[19] Johansson, T. M., Fernandez, J. E., Dalaklis, D., Pastra, A., & Skinner, J. A. (Eds.). (2023). *Autonomous Vessels in Maritime Affairs: Law and Governance Implications*. London: Palgrave Macmillan.
[20] Choi, J., & Lee, S. (2022). Legal Status of the Remote Operator in Maritime Autonomous Surface Ships (MASS) Under Maritime Law. *Ocean Development and International Law, 52*(4), 445-462. doi:10.1080/00908320.2022.2036276
[21] Lee, C., Kim, Y., & Shin, Y. (2021). Data usage and the legal stability of transactions for the commercial operation of autonomous vessels based on digital ownership in Korean civil law. *Sustainability (Switzerland), 13*(15). doi:10.3390/su13158134
[22] Li, S., & Fung, K. S. (2019). Maritime autonomous surface ships (MASS): implementation and legal issues. *Maritime Business Review, 4*(4), 330-339. doi:10.1108/MABR-01-2019-0006

4. RESEARCH METHOD

A qualitative research approach was adopted by the project partners to collect seafarers' voices from around the world. A semi structured qualitative interview guide was designed to obtain in-depth insights regarding seafarers' organisations and their involvement in MASS. The interview guide provided ample structure for the interview process while at the same time providing sufficient flexibility to the interviewees to engage with the topic in-depth. The research instrument focused on the seafarers' organisations' understanding(s) of MASS; their involvement in the development of the IMO MASS instrument; involvement with the national government in connection with MASS; involvement with employers in connection with MASS; engagement with other entities regarding MASS; their address to key maritime stakeholders (IMO – the international regulatory body, national government(s), and employer(s); and their recommendations for the way ahead.

There were a total of 17 research participants from 14 countries (see figure 12) across 4 continents (North America, Europe, Asia, and Africa). The research participants occupied leadership and other key positions in the seafarers' organisations. The participants' organisations taken together represent nearly 353,000 member seafarers. Of the 17 research participants, 16 were interviewed and 1 participant provided typed responses to the interview questions. The experience of the participants was varied and included lobbying and negotiation, seafaring (including command), defence, legal, superintendent, rail transport sector, education and training, doctoral researcher, ILO and IMO expertise.

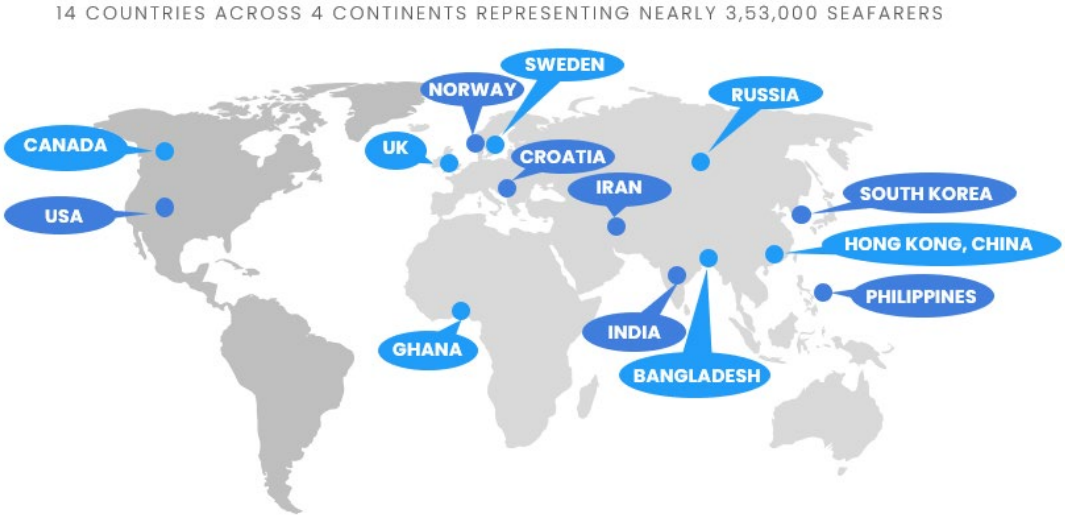


Figure 12: Countries covered in the KMI, ITF, and KIMFT MASS Human Element Project (May 2023)
Source: ITF

The research interviews were conducted online on Zoom and were video recorded. Each interview lasted for an average of 55 minutes. The interviews were summarised retaining the essence of the discussion and select key extracts were transcribed verbatim. The interviews were thematically analysed to identify the themes in the data indicative of the important areas to seafarers' organisations in connection with MASS. The 16 interview summaries are available in the appendices of this report. The findings of the research are presented in section 5 of this report.

Table 2: Countries, participants, and declared membership (May 2023)

S.No.	Country	Participants	Seafarer[23] members	Female members
1.	Philippines	2	111604	4200
2.	United States of America	1	58671	5062
3.	Russia	1	57000	2300
4.	Republic of Korea	1	34428	28
5.	Hong Kong, China	2	24955	10
6.	India	1	19750	30
7.	Canada	1	15353	1582
8.	United Kingdom	2	11027	948
9.	Croatia	1	10281	476
10.	Bangladesh	1	3680	100
11.	Norway	1	2782	31
12.	Sweden	1	2166	210
13.	Iran	1	1000	0
14.	Ghana	1	300	12
Total		17	352,997	14989

Source: ITF

The women membership information with the ITF covers diverse maritime sectors, including seafarers. It has been highlighted that increasing technology in the shipping industry leading to MASS could facilitate gender equality and promote the increased engagement of women in the maritime industry[24] along the lines of United Nations Sustainable Development Goal 5 on gender equality (UN SDG 5).

[23] Descending order

[24] Narayanan, S. C., Emad, G. R., & Fei, J. (2023). Key factors impacting women seafarers' participation in the evolving workplace: A qualitative exploration. *Marine Policy, 148*, 105407. doi: https://doi.org/10.1016/j.marpol.2022.105407

5. RESEARCH FINDINGS

This section presents the findings of the project arranged thematically for ease of reference.

5.1 The evolving role and agency of seafarers' organisations

The role and work of the seafarers' organisations have evolved significantly over the last century. From the collective bargaining agreements on basic worker rights, worker safety, working conditions, job and financial security, hours of work and rest, health care, and social welfare, the role of seafarers' organisations has undergone a sea change to meet the challenging requirements of the 21st century. In relation to MASS, the role and work of seafarers' organisations goes beyond previous agreements. In addition to worker safety, human resource development in terms of training and competence development for workforce sustainability becomes crucial in the transitioning maritime industry. Upskilling, reskilling, and retraining through lifelong and continuous learning become vital for remaining relevant in the rapidly evolving maritime industry. With respect to MASS, seafarers' organisations today require a strategic plan for the transitioning industry and the future in line with their philosophy and mission. Several seafarers' organisations have indicated the requirement of a Collective Bargaining Agreement specific to MASS – a MASS CBA.

The agency of seafarers' organisations' is evidenced by their efforts to be in the know. This is linked to other key findings regarding stakeholder engagement, communication, and the need for information. Seafarers' organisations are proactive – they prioritise and push themselves into conversations around MASS. Their representatives develop long standing relationships with key stakeholders, including with the government. Their agency helps them get invited for consultations as all national governments may not have an obligation to consult seafarers' organisations.

> *"They are not reaching out to us. It is up to us to reach out to them to have that discussion. We have to seek opportunities and make opportunities to provide our viewpoint. If we don't, it happens without us."* (Interviewee 10)

The seafarers' organisations note the distance between their membership and the high levels of decision making in the maritime domain. They align their efforts in the best interests of their members.

> *"A regular seafarer member is not going to have the ability to have those conversations as the decision-making process is happening at the government level."* (Interviewee 2)

> *"We want to be sure that the end result protects seafarers as much as possible."* (Interviewee 2)

5.2 Seafarers' organisations' engagement with other maritime stakeholders

Seafarers' organisations engage with other maritime stakeholders in connection with MASS development. These stakeholders include, but are not limited to, international regulatory bodies such as the IMO and the ILO, national regulatory bodies, non-governmental organisations, other seafarers' organisations, technology developers, Maritime Education and Training (MET) institutes. However, the interviewees mentioned that there is limited engagement with the national governmental bodies, ship owners, employers, and shipping companies due to the dynamically evolving phase of the industry. The following sub sections address the types of engagements, constraints and expectations.

5.2.1 Seafarers' organisations' engagement with the IMO in connection with MASS

Of the 14 seafarers' organisations that participated in the research project, 5 (89,999 members) engage with the IMO and 9 do not/have not had the opportunity (262,998 members). Figure 13 below depicts the breakup between the maritime organisations with their membership that engage with the IMO vis-à-vis those that have not.

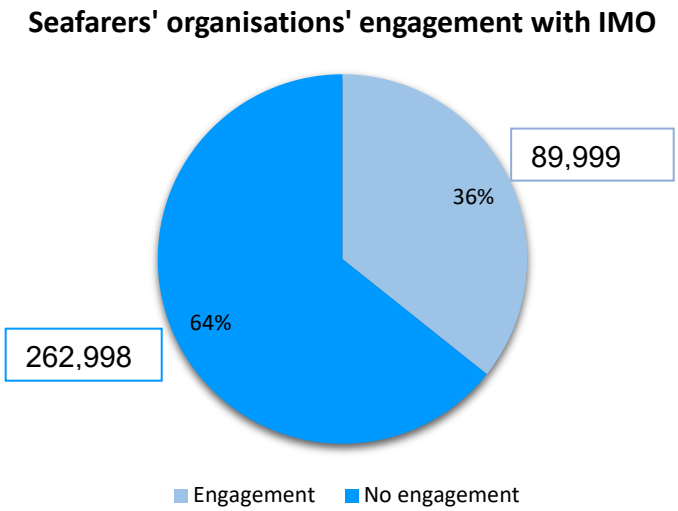


Figure 13: ITF affiliate seafarers' organisations' engagement with the IMO and seafarer representation (May 2023)
Source: ITF

5.2.2 Seafarers' organisations' engagement with the National government on MASS

Seafarers' organisations' engagement with the respective national governments offers a mixed result. Of the 14 maritime organisations across the world which participated in this project, 5 engage with the national government on MASS, 5 do not, and 4 stated that they

engage with the national government on issues, other than MASS but will discuss MASS when it comes on the agenda. MASS is currently not very high on the priority for some countries as there are other pressing issues such as education and training, welfare, resource availability, internet provision, and job security among other issues. In the future, seafarers' organisations would need to amend the membership criteria to reflect the changes in the industry due to MASS. Until the discussions commence on MASS, seafarers' organisations ensure that they are on the radar of their respective governments with their work on maritime issues.

5.2.3 Seafarers' organisations' engagement with employers / shipping companies / ship owners in relation to MASS

Seafarers' organisations would like to discuss the operational and manning requirements directly with employers to support their members with their jobs. They would like to train their members according to employers' needs so that they can be employed/employable in the changing maritime industry. Out of the 14 seafarers' organisations that participated in the research project, 8 have not engaged with employers in connection with MASS including 2 Organisation for Economic Co-operation and Development (OECD) countries. Seafarers' organisations from 6 countries which include 4 developed OECD countries indicated that they have had a limited interaction with employers related to MASS, however, would like to have conversations around MASS with employers in five years' time. The lack of seafarers' organisations' engagement with employers concerning MASS highlights that employers have not embraced significant advancements in technology in their fleet as of now. This finding has a bearing on another key finding related to the timeline of MASS development discussed in section 5.4.

5.2.4 Seafarers' organisations' engagement with other entities with respect to MASS

Seafarers' organisations strive to engage with other entities on MASS to be aware of the developments in the area. Their leaders engage with diverse entities that include simulator training providers, industry groups, and other seafarers' organisations and unions in different countries to prepare themselves for the road ahead. International cooperation is extremely important and an essential part of finding out what they need to be aware of. Of the 14 participant seafarers' organisations, 8 said that they engage with other entities in connection with MASS and 6 do not.

According to interviewee 2, some seafarers' organisations in other countries such as Norway could be further along. Developments in Norway could have a similar impact on other similar countries with respect to technologies considered onboard, and the impact on the membership of seafarers' organisations.

> *"What they are seeing today, we may see in 2-3 years, so it gives us some insight into what to expect."* (Interviewee 2)

5.2.4 Seafarers' organisations and MASS Policy

Out of 14 seafarers' organisations that participated in the study, 12 do not have a MASS policy and only 2 organisations from OECD countries have a MASS policy in place. This highlights the lack of strategic direction in the MASS space as these are still early days for the seafarers' organisations.

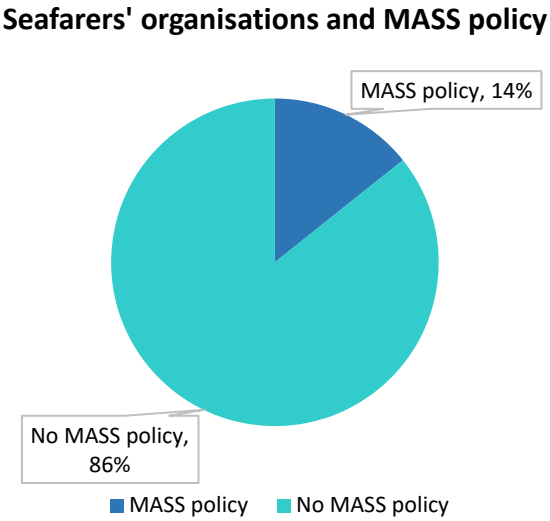


Figure 14: ITF affiliate seafarers' organisations and MASS policy
Source: ITF

5.3 Seafarers' organisations' address to diverse stakeholders

The research project gives the seafarers' organisations the opportunity to address key maritime stakeholders. Their views are presented in this section.

5.3.1 Seafarers' organisations' address to the International Maritime Organization

It is difficult for most seafarers' organisations to engage with the IMO on maritime related issues. This research project provides them with an opportunity to make their voices heard. When given an opportunity to address the IMO, the seafarers' organisations indicated that a level of anxiety exists in the maritime industry regarding the lack of clarity around MASS and its impacts on the maritime workforce. A key impact of MASS is seen by seafarers' organisations' members as resulting in a large number of job losses. These organisations would like the IMO to send a positive message and make clear that there are still jobs at sea and would be there for the foreseeable future until MASS becomes a reality in the next couple of decades. The seafarers' organisations would like the IMO to send a clear message and indication regarding the kind of education and training, and experience required to work for MASS. Seafarers' organisations want the roles and

responsibilities of the Master / crew / seafarers / operators to be crystallised with respect to MASS. Without clarity, it is challenging to envisage the needs of the future and how to best prepare to meet those needs.

Seafarers' organisations would like to tell the IMO that MASS influences multiple aspects of the industry – ship construction approaches, equipment, seafarers'/operators' roles and responsibilities, navigation, search and rescue, environmental protection, cargo operations, port approaches, communications, loading, discharging, on board maintenance, rules of the road, etc. Seafarers' organisations need to work together with stakeholders to get a clear understanding of the changes underway. This is directly connected to the need for information, cooperation, collaboration, and stakeholder engagement. The interviewees would like the IMO to encourage stakeholder engagements that include the seafarers' organisations at the highest levels.

Another aspect that has emerged is the differing resource availability, priorities, and commitment to the development of MASS in developed and developing countries. Some developing countries would like the IMO to consider the varied development of MASS across different world regions and lend its support to create a level playing field for all in connection with MASS. An interviewee from a country under sanctions wanted to request the IMO to create an apolitical safe area in the country for MASS development where work could be carried out through non-state actors, such as maritime organisations, seafarers' unions, and universities. This would help utilise the country's human resources and ensure that they are not left behind in these new developments. The maritime organisations from developing countries that participated in the project would like the IMO to address the imbalances in the development of MASS in the different world regions.

Seafarers' organisations have experience in addressing the issues pertaining to resultant job losses due to disruptions caused by the previous industrial revolutions. They would like this experience to be valued and drawn upon for the benefit of the maritime industry.

> *"What I would like for the IMO and administration and decision makers at large to understand is, and this speaks to the history that we as unions bring to the table, our experience during the last industrial revolution and industry 4.0 will have a similar impact of shifting the industry. It took three generations to recover from the economic impact, upset, and loss from the industrial revolution and that's not acceptable. As we move forward with this, we need to take the social aspects into account."* (Interviewee 10)

5.3.2 Seafarers' organisations' address to the national government

Most seafarers' organisations participating in this research project responded that they are not readily invited to their governments' discussion tables on MASS. They show considerable agency to remain visible in the national maritime space. Communication between the seafarers' organisations and the national government is extremely important, therefore, they would like avenues/channels to communicate with their respective governments and be invited for discussions. Seafarers' organisations would like the national government to support them and highlight the pathway to keep abreast of the ongoing changes. They would like the government to give guidance to the industry

regarding job security and putting in place an education and training plan for being relevant as the industry evolves. Since employment figures are important to the national economy, the seafarers' organisations would like the national governments' support on MASS as it evolves.

Seafarers' organisations would like to address manning requirements with the government, the supply of skilled labour, and would like clarity on the updated syllabus / curriculum for the training. The seafarers' organisations would like the government to develop the table of competences for MASS ship operators for all classes of MASS ships. A clear understanding of the competences is also required for the personnel in the ROC. Along with this, an understanding of how to approach the identified competences and their assessment is required. The seafarers' organisations want clarity on the certification schemes for the MASS workforce. They want the national governments to clarify the background and experience needed with respect to the teachers/instructors of MASS ships. The clear delineation of competences and the quality of the instructors is the responsibility of the governments according to the interviewees. The seafarers' organisations would like clarity on the funding for the training. Would the government or employers fund significant investment in training or, would the seafarers' organisations be responsible for funding the same?

Seafarers' organisations note the reduced crew strength onboard current ships to an average of 20 or less crew and the accompanying work intensification this has caused. This has repercussions for the mental wellbeing of the crew as they could feel isolated. This also has repercussions for the International Convention on the Standards of Training Certification and Watchkeeping (STCW) and its Code and the Safety of Life at Sea (SOLAS) and its associated instruments as crew members in sufficient strength are needed on board for carrying out training drills for emergency response and management such as firefighting, abandon ship etc. A further reduction of crew onboard would not be conducive for undertaking group training drills onboard and would be in non-compliance of concerned international safety regulations. The seafarers' organisations would like discussions all the issues highlighted in this section with national governments.

> *We as a union would be worried about the displacement of seafarers with systems, due to the economic impact on the social fabric.* (Interviewee 17)

Job assurance, and the safety and security of the crew onboard are paramount concerns for the seafarers' organisations. These concerns are the same as they have been in previous decades. Figure 15 below delineates what the seafarers' organisations would like to discuss with their national governments.

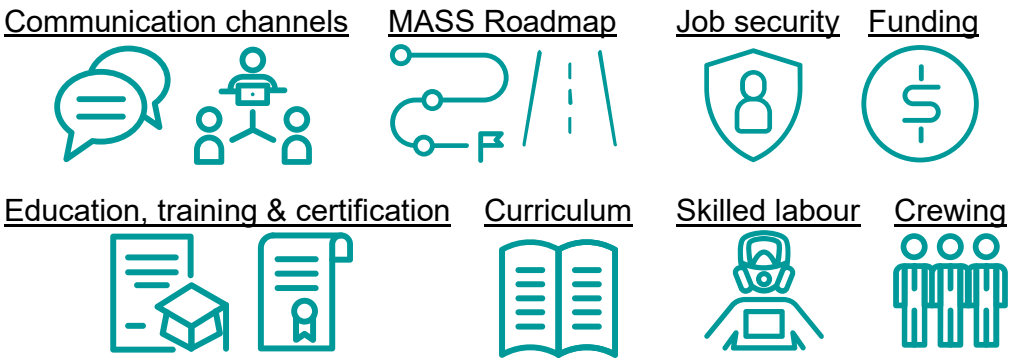


Figure 15: What seafarers' organisations would like to address with national governments

5.3.3 Seafarers' organisations' address to employers (shipping companies/owners)

The majority of the participating seafarers' organisations have not yet engaged with employers on MASS. This is largely because most employers have not yet adopted MASS in a significant manner across their current fleets. Seafarers' organisations note that shipping companies would need to be prepared for technological advancements. According to the seafarers' organisations, a lot of the conversations around MASS have previously been led by technology providers who have presented a skewed perspective on how quickly MASS would advance. This is different from the ground reality. Most seafarers' organisations have not had detailed discussions with employers as –

> *"We often look too far down the line. We're looking at the end goal. For a lot of ship owners right now this is not on the radar; they're not talking about it, so, we're not talking about it. We're all going to have to at some point potentially but, this is what happens; the technologies are there, the ideas are there but if it costs a lot of money, if it takes a lot of time, it's not a priority at the moment. The priority for our ship owners anyway is for securing contracts and ensuring a healthy bottom line."* (Interviewee 2)

With employers, the seafarers' organisations would like to address the following points:

- Clarity on future operations and scale – at sea or shore-based operations!
- Clarity on crewing levels.
- Clarification of the roles, responsibilities, required training, and designation.
- Understanding and developing levels of the seafarer/operator involvement corresponding to degrees of MASS.
- Job creation as a result of MASS! What jobs can seafarers apply for in the new environment?
- Funding/investment from shipping companies in developing maritime human resources.

5.4 Timeline of MASS development

Given the lack of readiness of the technology in commercial shipping, it's sluggish limited uptake by employers, the life span of new built commercial ships of today, lack of regulation, lack of supportive infrastructure, skilled manpower availability, and issues pertaining to insurance, the commercialising of MASS degrees 3 and 4 ships is at least two decades away according to the interviewees. In the best-case scenario, they are at least a decade away. Some seafarers' organisations go as far as to say that it may be a distant dream that remains unrealised. According to seafarers' organisations, MASS is currently a developing/evolving concept and degree 4 of MASS is the furthest away and least relevant to a lot of current conversations. The industry notes the significant developments in Information Technology (IT), digitalisation, and automation; however, it lacks the appreciation of higher degrees of MASS ships. There is a huge gap between the envisioning of MASS and its uptake in the industry. According to an interviewee, discussions and engagements on social media do not centre around MASS but rather on other issues such as decarbonisation, green power/energy sources, new power and propulsion systems, onboard electronics, wind power, and seafarers' welfare. In such a scenario, MASS comes across as a niche area far from reality, even more so for developing countries.

According to some interviewees, the initial views on MASS came from technology providing companies that leaned more on the marketing side. In reality –

> *"Things were not quite as far along as they were saying they were."* (Interviewee 6)

> *"The elephant in the room is unmanned ships. They're not doing it overnight. Ships are built to last 20-30 years, by that time you would be retired."* (Interviewee 9)

> *"So, whatever you do, you cannot say a ship is unmanned. It's not so easy as you think. You cannot take a ship and put it in the sea and say bye for the next 20 years. You fix yourself. It's not possible. Sorry."* (Interviewee 1)

According to the interviewees, the use of 'MASS' as a term projects wrong ideas to the seafarers and the industry. The focus on autonomy and automation, and artificial intelligence invokes people to think about the distant future and makes them jump to wrong conclusions.

> *"The way that MASS has been presented has put a lot of people off because they jumped to the end stage instead of what truly is next…We're not going to see vessels that run completely autonomously with no people on board with nobody operating it from the shore side. This completely autonomous vessel making its own decisions out in the water without any human involved, that's way down the road…What is more realistic is the short term and by the short term I mean 15-20 years quite frankly is highly automated systems and that's what we should be talking about…Positions on board will always exist; there may be a reduction in the number of people on board in those positions."* (Interviewee 10)

The regulation of MASS commenced before its full development and uptake which has proved to be challenging for maritime stakeholders. There is a lack of clarity in the industry around regulating MASS. The IMO Regulatory Scoping Exercise for MASS was completed in 2021 and with the MASS code currently under development, the regulatory environment is not clear to all maritime stakeholders.

> *"The IMO was pushed into it by the hype around autonomous systems and then they found themselves down the road where they were trying to regulate something that didn't exist yet, which is not normally the way of doing things. Normally, the safety case is proven and then proposals are made to regulate new systems that have come into operation; not trying to develop regulations for something that no one knows what it is."* (Interviewee 6)

MASS has been presented as one of the solutions for environmentally friendly vessel operations. However, it's uptake will depend upon several factors. Concerns have been raised regarding the notion of marine environmental safety and autonomous vessels. Given alternate energy sources/fuels, vessel engines, and the nuances of the stored cargo –

> *"An unmanned vessel in the middle of the Atlantic is not ideal for environmental protection."* (Interviewee 5)

> *"They would need to tread cautiously as for instance an accident involving some of the vessels such as ones carrying dangerous chemicals can have dire consequences for humanity."* (Interviewee 17)

There would be initial resistance from the industry itself to adopt MASS as it is not only about advanced technology but also about the maritime service business that includes customer service and reliability. The shipper may not trust an unmanned vessel to effectively protect their cargo. Human involvement in cargo movement is also to be considered from this business perspective. Crew will be onboard for the foreseeable future, albeit in reduced numbers. Ship operations are much more than navigation; they include emergency response and management as well. In emergency situations, the computer cannot be solely relied upon to mitigate the crisis. Competent personnel are needed onboard who know the characteristics of the energy they have used and stored aboard the vessel for emergency response.

Conventional ships are built to last for at least 20 to 30 years. Ships that are currently being delivered from the shipyards and those under construction would serve the industry at least for the coming two/three decades. This time should be well utilised to prepare for the advent of MASS and planning for any foreseen disruptions due to it. Significant funds would need to be invested in redefining education and training and executing the newly envisaged training programmes – reskilling/upskilling/retraining, curriculum development, and certification requirements. For realising MASS, attention also needs to be given to ship design and construction, port infrastructure etc. The maritime sector is much more than MASS and stakeholders need to have all encompassing discussions for clarity.

From a practical point of view, a lot remains to be addressed before MASS can become a widespread reality. Seafarers' organisations cannot stop MASS but can help regulate aspects of it. Several legal issues need to be considered first including questions around liability, accountability, and insurance. There are no quick fixes with respect to MASS. According to an interviewee, a lot needs to be addressed to comply with the Convention on the Facilitation of International Maritime Traffic (FAL Convention) before doing other things in the space. A huge amount of work remains to be done on automation and workflows; on the technology to prove that it works and ensure its reliability and efficacy. The four degrees of MASS defined by the IMO may not be suitable given the complexities on the ground. The seafarers' organisations need more clear definitions and descriptions about what is exactly been talked about in connection with MASS. The work undertaken today with respect to MASS impacts personnel a couple of decades down the line when today's workforce would be considering retirement/retiring and those just starting out would face disruptions to their seagoing career. The commercialisation of MASS at the moment is at least more than a decade away.

5.5 Diverse understandings of MASS

The seafarers' organisations provide nuanced and diverse understandings of the concept of MASS. As highlighted by the IMO, MASS comprises four degrees of ships which include unmanned vessels. However, there is a tendency in the industry to go to the extreme degree 4 when MASS is mentioned. Due to this, MASS becomes synonymous with unmanned vessels and 'MASS ships' and 'Non-MASS ships' enter the industry vocabulary. MASS is not seen as four distinct categories with gradual inter-category progression culminating in autonomous degree 4 ships. There is inherent fluidity in operations as these degrees are not seen as watertight silos. The same vessel may operate in different degrees of MASS; or an entirely new vessel would need to be designed specifically for degrees 3 or 4 ships. The jump from humans onboard to unmanned is significant and disruptive and has repercussions for the entire maritime industry and the supply chain. While seafarers could lose their jobs, there would be other opportunities created ashore and onboard in the evolving maritime ecosystem. One definition of an unmanned ship provided by an interviewee is –

> MASS is *"Unmanned ships that are operated by a computer."*
> (Interviewee 14)

According to one interviewee, *"MASS is entirely the wrong name"* (Interviewee 10). MASS is the wrong term to use as the industry is currently looking at highly automated ships. Multiple ship types exist and there is not enough of a distinction between highly automated ships and initial MASS stages, and there are completely different requirements for the leap from the highest level of automation to autonomy. MASS encompasses more than the name suggests. It spans the whole continuum and all levels of automation and autonomy that are not captured by the term. Instead of MASS, we should be talking about highly automated systems - engineering systems, firefighting systems, navigation

systems, remotely operated systems, etc., where the systems are automated and integrated, but people are present onboard with designated duties.

> *"I don't talk about totally unmanned ships anymore…Smart ships and intelligent people."* (Interviewee 1)

MASS is still relatively new for the industry and there is considerable confusion, and lack of clarity around it.

> *"This is new for everybody. We are all winging it. Nobody has experience in this yet."* (Interviewee 10)

The implementation of MASS has the potential to increase efficiency, reduce cost, enhance safety, and improve environmental sustainability. Conversations around MASS are intertwined with conversations around novel technologies, digitalisation, alternate fuels, decarbonisation, just transition, and environmental sustainability. According to one interviewee everything is alright when the weather is nice. However, in challenging conditions such as bad weather, ice, saltwater impact on lithium-ion batteries, etc., anything can go wrong. In such scenarios competent personnel are required on board in the event of emergencies such as fire.

MASS is considered both evolutionary and revolutionary. As reflective of Industry 4.0, MASS is seen as a potentially disruptive technology that will greatly impact seafarers and the labour market. The disruption caused due to MASS would be akin to previous industrial revolutions in terms of completely reshaping the labour market and the industry. With respect to the disruptions due to technological advancements, seafarers would need to be prepared to take advantage of the opportunities presented by MASS.

> *"You have to be ready. You have to be afloat."* (Interviewee 12)

5.6 Stakeholder engagement and communication

There is a need for tripartite stakeholder engagement and dialogue on MASS. Cooperation, collaboration, and open transparent communication and information sharing between maritime stakeholders are required to facilitate a fair transition in the industry. Significant efforts of seafarers' organisations go towards connecting with stakeholders to learn where the industry is heading and to try and shape the developments by making themselves heard. Tripartite communications between the flag, the industry, and seafarers' bodies are required to understand the level of manning, the competence, and the qualifications of the seafarers/operators of the future. Seafarers' organisations would like to ensure labour involvement in conversations.

> *"What we don't want to see is an advancement of all these conversations that don't consider the worker."* (Interviewee 2)

5.6.1 Convey seafarers' voices

According to the seafarers' organisations, tripartite discussions on MASS are extremely important as they would involve the three major stakeholders - the government, the employer, and the employee. The need of the hour is cooperation, collaboration, and transparent dialogue. The advances of Industry 4.0 in the maritime industry with MASS require joint efforts as no stakeholder can proceed alone. It is important for the seafarers' organisations to have a channel to connect to the IMO. One channel is to go through the national governments which is not easy. The seafarers' organisations can indirectly participate in the IMO through the ITF. According to an interviewee there is a difference when seafarers' organisations speak on behalf of their members and when the national governments address the IMO while representing the member state. The seafarers' organisations represent the workers – the human resources, their safety and security, and matters concerning them, whereas the government could be concerned about other issues, including the financials.

> *"I can't imagine collaboration of an industry group like the Human Element Industry Group ten years ago. I wouldn't have imagined the ITF and the ICS[25] sitting together meeting outside of IMO meetings and working towards a common cause."* (Interviewee 6)

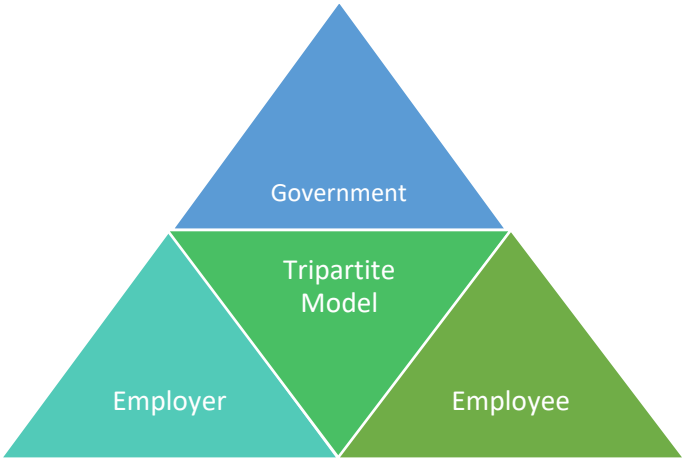


Figure 16: Tripartite model of engagement

Joint stakeholder dialogue on the impact of autonomous technology on the human element is essential. Seafarers' organisations advocate for joint dialogue and decision making with seafarers' welfare and safety taken into consideration. Stakeholders need to talk about technology, its impact on the seafarer, evolving ship design, roles and responsibilities, training and development, regulatory environment, and cost considerations.

> *"We tend to talk in silos, which is not good for anyone. Everyone needs to be at the same table...having these conversations so that we are all prepared, and whether that happens quickly or whether that happens over decades at this point, which I think is most likely, it's good."* (Interviewee 2)

[25] International Chamber of Shipping

5.6.2 The IMO and the ILO system of stakeholder engagement

In the ILO, the Special Tripartite Committee (STC) sit as equals on tripartite discussions and decision making. According to an interviewee, a stronger document is produced if it has gone through the tripartite discussion process prior to going to the legal committee for endorsement. Within the IMO the discussions take place within the various committees and sub-committees where member states take precedence. According to an interviewee, the IMO needs to reflect on how to engage with seafarers and employers. An interviewee would like the IMO to elevate its conversation with seafarers and employers in a meaningful manner to provide a balanced input to the discussions. For one interviewee,

> *"It is a bold ambition to wish the seafarers and shipping companies equal to other stakeholders at the IMO."* (Interviewee 14)

Nevertheless, they would like an opportunity to have tripartite discussions. The ILO and IMO have come together on the maritime human element with the entry into force of the MLC 2006. As the technical maritime regulatory body of the United Nations, the IMO has the mandate to initiate dialogue with the ILO on seafarers' matters.

5.6.3 The need for information and transparency

The seafarers' organisations do not know enough about MASS, and neither do most of the employers. Seafarers' organisations look towards other entities for information to understand what they should be negotiating about. They are not aware of all available options as the MASS concept is still evolving and the industry is in a flux. Seafarers' organisations attempt to have high level conversations with their national governments to get an idea of what's coming; what to expect; and what the long-term plans are. It is for them to identify forums where pertinent topics are being discussed and seek participation highlighting their agency. Alongside the government, seafarers' organisations need robust engagement with technology manufacturers and employers to unpack future training needs.

> *"There needs to be more information sharing because we don't know what the options are. We don't know what the impacts are because we don't know the technology that's developing. We don't know what we don't know."*
> (Interviewee 10)

5.6.4 Connection and information dissemination

Information sharing on different levels such as the seafarers' organisations, the government, and the IMO is required for raising awareness of developments in the MASS ecosystem. A key role of the seafarers' organisations is to create channels of communication to reach out, connect, and disseminate knowledge, ideas, and pertinent decisions. They strive to keep their members updated on national and international issues, seafaring matters, facts, and knowledge of use to them. Social media such as Facebook and WhatsApp groups are utilised to reach out to seafarers, in addition to emails to keep them informed of all developments. At times the meetings/workshops/events may be

conducted in the hybrid mode to enable seafarers who are working onboard ships to connect if they can.

Robust communication technologies underpin the realisation of MASS without which it would remain a distant reality. Radio and satellite communications are at the heart of MASS. Without stable, safe, and reliable communications between the ship, port, cargo owners, Vessel Traffic Service (VTS), Rescue Coordination Centre (RCC), Remote Operations Centre (ROC) etc. achieving MASS operations would not be possible. The interaction between the ship and the shore will continue to increase with higher degrees of MASS. The success of online meetings depends upon achieving internet connectivity. The internet connection needs to be robust to provide a seamless experience. Currently, the connectivity depends upon the distance from the shore, among other factors. The quality of ship communications is not ideal at all times. According to an interviewee, the meetings conducted in the hybrid mode may not be interactive but are informative. Added to this is the challenge of the limited time available to the seafarers for using the internet onboard. At times the internet usage onboard could be restricted to a few minutes which would pose challenges for a host of issues such as remaining connected to family and friends, and undertaking any online education and training, among other uses.

Internet connectivity for seafarers is a basic human right. It contributes towards their social welfare and mental health. The social wellbeing protections and provisions of seafarers are extremely important. With a skeletal crew, work intensification, less social interaction and reduced shore leave, crew wellbeing becomes difficult to ensure. It is not only about the remuneration but also about the guarantees that the maritime industry can give them when seafarers work in the industry. Internet connectivity is the least the industry can do to support its workforce. According to an interviewee, workforce from labour supplying countries consider internet connectivity as part and parcel of their lives, therefore limited/no connectivity onboard would make it difficult for the industry to attract younger generations in sufficient numbers.

> *"You cannot take half of my salary just to stay connected. It becomes a basic right to stay connected."* (Interviewee 7)

Tripartite stakeholder engagement, communication, dialogue, transparency in information sharing, information dissemination, and connectivity are important for the development and implementation of MASS. There should be synergies between seafarers' organisations, seafarers, regulators, employers, research and development entities, training institutes, and technology developers to achieve MASS in a meaningful manner.

5.7 Unequal regional development of MASS

Developing MASS is a technology forward resource rich enterprise. There is an unequal pace of development of MASS in the different world regions due to the (un)availability of resources, differing national requirements, (lack of) skilled labour availability, different priorities, and geographical considerations. The economically developed countries and/or well-resourced technology and shipping companies are moving first in this space. The

adoption of high technology may not be beneficial for all at the outset. There is an imbalance in the development of MASS in developed/OECD and developing countries and the industry needs to find a balance to make it work for all. The IMO would need to pay attention to this gap between the developed and developing nations in relation to MASS. A balance in the discussions would need to be created for the benefit of all/most rather than a limited few. In relation to MASS, the IMO would need to strive to achieve –

> *"The greatest good for the greatest number."* (Interviewee 8)

MASS is not only limited to the vessel itself but the entire ecosystem of infrastructure to support its development. Countries in the European Economic Community (EEC) are more involved in MASS, and it is not being taken up in a significant way in the global south. Seafarers' organisations see a demarcation in the MASS space; on one side is the resource intensive technological development of MASS vessels/technology itself; on the other is the service/reception/labour space. Some interviewees note that their countries may not be developing MASS vessels at the outset but would like to receive and service MASS vessels when they visit these countries' ports. Substantial national investment in resources (human and infrastructure) would need to be addressed via robust legal frameworks to adapt and welcome MASS in the national waters of developing countries. Countries which do not have the infrastructure to support MASS and are not ready with respect to the training of seafarers/operators for these advanced ships, will lose out in the long run. The countries which are prepared for the transition to MASS will emerge as winners. The development of MASS could be regionally restricted if developing countries are left out. They should be given time and support to develop MASS at the same speed as elsewhere in the world. This would help to facilitate expand MASS operations in the whole world. MASS presents diverse opportunities that range from technology development, support, repair, servicing, education and training, infrastructure development etc. Different countries can capitalise on these diverse opportunities based on their strengths to support their national economies in the MASS space.

> *"If developing countries do not have the infrastructure to receive such vessels, we could have a situation where MASS vessels only sail in Northern Europe."* (Interviewee 3)

> *"We are not opposed to automation, but it needs to be used for the benefit of everybody."* (Interviewee 2)

Traditional labour supply countries need to upskill their workforce for the evolving industry. Representatives from major labour supplying countries have indicated that their efforts would include developing training and development policies and supportive infrastructure for their human resources to be employed in the changing industry. Additional challenges are experienced by countries under sanctions as they are unable to dedicate resources to novel technological developments and keep pace with developments elsewhere in the world.

Geographical consideration and routes are important factors for MASS deployment. According to an interviewee MASS is more suitable for short run trading/voyage. MASS is largely not considered suitable for crossing the oceans in autonomous mode. One

interviewee stated that even though they have a network of rivers and sea routes, MASS is not suitable for the region as the waters are very rough during the monsoon season. Due to rough seas for nearly seven months out of a year, deriving the benefit of a short route is not available in the region. If the success case can be proven for the short and medium route, then longer routes can be explored.

> *"I think it's going to take a long time until everyone is happy with the short trade route of MASS."* (Interviewee 4)

MASS is suitable for ships engaged in short run trading/voyage in resource rich regions where the seas are not rough. The success of MASS depends upon the routes, regional geographical characteristics, infrastructure readiness/availability, market dynamics, financial resources, competent human resources including education and training schemes, and regulatory readiness.

5.8 Technological developments and seafarers

Seafarers' organisations are in favour of technology. They are not against technological advancements that make the jobs and lives of their members better, safer, and easier. Technological evolution has always existed in shipping and the seafarers' organisations have extensive experience with this for over four decades. Technology has led to several improvements onboard ships and the increase in technology has led to a reduction in manpower, new knowledge and certification requirements, and work intensification that also has consequences for seafarers' fatigue and wellbeing. Maritime organisations want technology to support workers and not to be used to drive the fallacious argument of human error to replace them.

> *"MASS as a concept is not really new, it's only new when you look at the later degrees and the more autonomous systems on board or the self-regulating vessels."* (Interviewee 2)

5.8.1 Technology to support seafarers' working conditions

Technology should play a supportive role according to the maritime organisations. Human experience and knowledge are required to operate the ship safely, despite technological advancements. An interviewee is in favour of the development of robots that could undertake enclosed space entry that could potentially save lives. Remote control of winches from any position onboard the ship is a useful development that enhances safety by removing the seafarer from the proximity of the operation. Seafarers' organisations support seafarer trials of new technologies being developed in the test beds before the introduction of technologies onboard to understand how seafarers interact with the new technology.

> *"Our individuals and our people have never been anti-technology when it enhances their experiences, when it makes them safer, when it makes them feel more protected. When it helps to protect the maritime environment seafarers, maritime professionals embrace technology…Technology can be a*

great thing. Don't look at it as something to reduce the numbers on board. You need to look at it as something that can increase safety and improve the working conditions onboard. Take the seafarers with you…We are not opposed to MASS. We believe it's completely a fruitless task to try and argue against the development of technology. You can't uninvent something once it's been invented, but we believe the discussion should be framed around how the technology can be used to improve the lives of seafarers and workers in general and not as a means of reducing their numbers…The compelling need should be directed towards not replacing the seafarer and making the operation of ships cheaper by removing the bit that costs the least. The compelling need should be to make the job better, easier, and diverse. We should remove the dangerous tasks that are quite onerous such as the enclosed spaces. Why should we send seafarers there." (Interviewee 6)

Seafarers' organisations would like technology to be used to make seafarers lives easier and address seafarer fatigue. Seafarers are known to work unforgiving hours and seafarers' organisations would welcome technology to facilitate appropriate hours of work and rest.

"We should develop systems to support the seafarer to work less hours. (Interviewee 14)

"Technology should be used to help the seafarers to give them some time to rest but not to replace them." (Interviewee 7)

"We should use the advances in technology to make our lives easier, not to make it difficult…MASS is just an instrument for us to improve our lives." (Interviewee 9)

Seafarers' organisations want human contribution to safe operations to be acknowledged. According to the seafarers' organisations, the ubiquitous argument that human error causes 80% of the accidents and removing the human would help reduce the number of accidents to sell autonomous systems is fallacious. This argument does not take into account the number of disasters prevented due to the presence of humans.

"This argument doesn't take into account any error in design, programming, or coding. It doesn't take into account human contribution to safety."

(Interviewee 6)

5.9 Seafarers' organisations and MASS training

Seafarers' organisations closely follow developments in the MASS space and engage with diverse stakeholders to support their members with guidance on training and development in the fast-evolving industry. With the rapid developments of technology, the sustainable operation of the industry is challenging as it is difficult to find the competent human resources with the appropriate training. There is a need for competent and skilled crew and instructors for MASS operations. The role of human involvement in MASS operations is expected to evolve significantly. With developments in novel technologies, new energy sources to power and propel ships, new engines, novel developments in manoeuvring and

pollution prevention guidelines, seafarers need to be updated through lifelong and continuous learning.

According to the seafarers' organisations, the production of future seafarers would require educated and experienced seafarers at the centre of the process. Training of seafarers/operators of future ships would require a combination of technical, information technology, and non-technical skills that would need a collaboration between industry experts who make the technology with experts in the maritime context. Greater stakeholder engagement and collaboration would be needed in MET space.

Seafarers' organisations have the obligation to protect their members. While seafarers' organisations may get the opportunity to influence decisions, they do not have the power over outcomes. Therefore, maritime organisations strive to keep their membership informed of the changes in the industry to stay updated. According to the maritime organisations, in order to remain employed/employable in the industry, members need to be aware of the changes underway and prepare themselves accordingly. Accordingly, one seafarers' organisation organises seminars on decarbonisation, cyber security, logistics, digitalisation, supply chain etc. in which it condenses the learning for its members. One seafarers' organisation is in talks to procure MASS training simulators to train its members and help them prepare for the transition.

According to interviewees, MASS can be seen as an opportunity for securing jobs in the larger logistics chain. Shipping is a small part of the supply chain and when jobs move ashore to remote operation centres, seafarers should be considered first to be absorbed in the new workplaces. Additional training is recommended to serve on board the ultra-modern MASS ships. With respect to seafaring officer/operator training in which the individual would flexibly move between the ship and the ROC, the seafarers' organisations would like the individuals to be competent as per STCW (2010, as amended). Seafarers' organisations would like the STCW to safeguard their members. They are currently unsure if a separate MASS Certificate would be required for new recruits in the control centre.

> *"I strongly recommend we should have seafarers on-board who have the basic STCW training and if they were to serve on this type of remote-controlled ship then extra competence on top of that to serve on this type of ship."* (Interviewee 1)

> *"We have a shortage of seafarers globally… what we don't want to do is make some seafarers redundant to the point where they leave the industry and then you need a whole new batch of people coming in with new knowledge. What we should be doing is taking those seafarers whose jobs are potentially at risk to a certain degree and providing them with opportunities to take new training to learn new skills, to learn new competences, to have the certifications that the ships of the future are going to need."* (Interviewee 2)

> *"Shipping companies should not just abandon seafarers. They should help them adapt by developing them and giving them opportunities in order for them to be ready for higher degrees of MASS."* (Interviewee 7)

Seafarers' organisations would prefer to have seafarers onboard MASS ships trained according to the STCW as technology is fallible. In the event of a fire emergency, the fire needs to be put out and in case of adverse impact on the computers and other electronic systems –

> *"You need personnel on board the ship to take over the command and manually bring the ship safely to port."* (Interviewee 1)

Funding for the training and development in relation to MASS is an issue that requires deliberations between concerned stakeholders. It has been put forward that the entire exercise will need substantial funding and would not be possible without support from the governments and ship owners. According to the seafarers' organisations, seafarers should not be expected to pay for training required due to the wide sweeping changes in the industry. Shipping companies should take the responsibility for seafarer reskilling and training. According to one seafarers' organisation, some of the money that a company would get to save would need to be put in a programme to help displaced workers. There would be a number of opportunities due to MASS where seafarers can be absorbed ashore within the maritime cluster in repair and maintenance or in the shore based remote operation centre, or in other parts of the logistics chain. Seafarers' organisations would attempt to seek collective bargaining agreements with companies. As part of the MASS CBA, the seafarers' organisation can train the seafarers and they can continue to work for the same employer.

With respect to the remote operation centres ashore, seafarers' organisations prefer experienced seafarers to be placed there. The knowledge and experience that seafarers have is crucial and would need to be translated to the remote operation centres. Having experienced seafarers ashore would be helpful as there would be challenges with respect to the safety and the rules of the road in congested waters. There are instances where shipping nets also have the Automatic Identification System (AIS). This scenario would become more challenging in poor visibility. A host of sensors would be required, and one would need to be mindful of the time lag between the sensors capturing and sending information and the consequent line of action. In any event one would not wish to foul the propellor or have an accident with disastrous consequences for the environment. According to the seafarers' organisations the manning scale would need to be addressed for the remote operation centres and it is a big task. Workforce in adequate numbers would need to be inducted. Training would be important for the ROC operators, as they would need to be additionally trained in crisis management, and soft skills.

> *"They have to be seafarers. In the event that any advanced automation or meaningful reduction of personnel aboard ship will happen, you are going to use the people that you have taken off the ship and you have to use them on the shore."* (Interviewee 9)

The differential development of technologies in the different world regions and lack of standardisation also leads to challenges for the industry. Currently, energy transition for decarbonisation also urgently requires appropriate safety training provisions not only for the crew onboard but also for the shore-based personnel even in the global north. Training

is being developed to keep up with the pace of technological developments. However, safety is hampered due to oversight issues. There is a lack of universal understanding regarding how the overall MASS system as well as its technologies work. It is not acceptable that the limited lessons learned come from seafarer fatalities or injuries when the workers weren't properly familiarised and trained in the new technology to begin with. Education and training lagging behind the fast pace of technological development is a concern for everyone in the maritime industry.

5.9.1 The role and competencies of seafarers in MASS operations

The clarification of roles, responsibilities, competencies and designation is key project finding with respect to MASS vessel operations. On a conventional vessel, the deck officer when on watchkeeping duty is bound by the provisions of COLREGs. Physically, the Master is also bound to the vessel and is in direct control of, and responsible for the navigation and operation of the vessel. On the other hand, the remote operator or MASS master (role clarity required) engaged in the operation of the novel MASS vessel could be located outside the vessel in the ROC and would be able to anticipate and respond to potential hazards that may arise during the vessel operations. The role of seafarers onboard MASS vessels should be considered according to the mode of operation. If the MASS operation is remotely controlled, the role of the seafarer aboard the vessel will significantly evolve. The on-call duties of the crew onboard a remotely controlled and operated MASS vessel could be significantly less, presuming that the MASS voyage is incident free.

One finding concerns poor weather conditions and the need for human presence onboard to facilitate a safe return to port. In the scenario where the MASS operation is being conducted from the ROC and they are unable to maintain control of the operation due to adverse weather conditions, heavy traffic, communication challenges, or remote system failures, the operation control would need to shift onboard. If the mode of MASS operation shifts to the ship, the role of the onboard seafarers will increase as a consequence. The international instrument for MASS currently under development contemplates safe manning given that there would be a smaller number of on-call personnel on board. These personnel would need to have a greater understanding of the underlying autonomous operation, including the capabilities to respond in an emergency.

Along with the current requirements of the STCW 1978, as amended, seafarers aboard MASS vessels would need to possess pertinent information technology skills, the ability to interpret information, superior communication skills, an understanding of the automated/autonomous navigation system and emergency response capabilities to respond without delay when the system gets transferred to shipboard control from the ROC. Furthermore, in an environment where the use of digital technologies is significantly expanding, digital information literacy, knowledge of cybersecurity, and crisis response capabilities, as well as the capacity to comprehend and use the fall-back system of the automated/autonomous system are required. It appears that seafarers will need to gain additional sophisticated competencies for working onboard MASS vessels. The education system would need to be updated to bridge the gap between current and future training

requirements. Simulation training based on diverse MASS operation scenarios needs to be implemented utilising MASS training simulators that mimic real situations for skill development.

5.9.2 The role and competencies of remote operators in MASS

One key project finding concerns the absorption of redundant seafarers into the ROCs. The clear definition of the role, responsibilities, competencies, capabilities, and the designation of the remote operator is currently up for deliberations at the IMO. Based on the current technological developments, the roles, competences, and training of remote operators can be gauged. Remote operators would need to organise and execute MASS vessel operations at the ROC wherein a single remote operator could be in control of several MASS vessels conducting simultaneous operations. These operators would require knowledge of the entire MASS operating system, including electric propulsion. Additionally, they would require leadership skills to control the vessels remotely. They require superior communication skills to interact and communicate with other personnel at the ROC including for the handover process. They also need to communicate effectively with any seafarers onboard the vessels they are operating. These personnel also require emergency response skills, including for instances with equipment malfunctions. They should possess cybersecurity skills, risk forecasting skills, and the ability to control multiple vessels simultaneously. In addition to the aforementioned skills, the remote operators should have the knowledge and skills of traditional ship operations, such as the ship manoeuvring principles, COLREGs, ship stability, marine meteorology, port state control, ship-to-ship/ship-to-shore/shore-to-shore radio communications as per the IMO Standard Maritime Communications Phrases (SMCP).

Future workers who will occupy positions at ROCs should have a thorough understanding of navigation-related technologies and principles currently in use, as well as the capabilities and technologies necessary for operating the novel ships. It is anticipated that a former seafarer will acquire the additional competencies and skills necessary to become a remote operator via additional role specific training. Hands-on education, such as MASS remote operator simulation training using simulators for MASS operations, and remote operator training experience at the ROCs would be required to acquire the required fundamental skills. The simulation training for remote operators will necessitate the inclusion of various emergency scenarios such as marine traffic congestion, deteriorating weather conditions, MASS communication disconnection/breakdown, and emergencies such as fire, collision, blackout, etc.

The introduction of new occupations, such as remote operators in MASS, exemplifies the changing nature of work and necessitates a training strategy distinct from that of the past. To ensure that remote operators, who could be physically away from the vessel, possess the necessary competencies and skills, regulatory bodies, ship owners, employers and shipping companies, shipyards, and MET institutes will be required to develop a new remote operator training program based on active collaboration.

Even when MASS operations are wholly autonomous, humans will continue to remain in the loop. Therefore, it will be beneficial to analyse the gaps between

current and future training requirements in MASS operations to develop robust training programmes. When legal frameworks for MASS are established and implemented with the full cooperation of all concerned stakeholders, MASS education and training based on sufficient field trials, would support the industry in successfully optimising autonomous technology.

5.10 Recommendations and final thoughts

This section presents the final thoughts of the interviewees and their recommendations to the diverse maritime stakeholders on MASS. Wherever possible, their words have been given verbatim for authentically presenting their voices to the maritime industry.

The inevitability of MASS is noted by the seafarers' organisations; however, they urge caution in its development and implementation.

> "*It is inevitable that MASS has come to stay. However, the impact of this system on mankind has not been properly weighed against the seeming benefits. They would need to tread cautiously as for instance an accident involving some of the vessels such as ones carrying dangerous chemicals can have dire consequences on humanity. Those remotely controlled robots were made by humans and will be operated by humans and can also FAIL."* (Interviewee 17)

There is a lack of clarity in the maritime industry around MASS and seafarers' organisations have several questions for the IMO as the technical regulator of international shipping. These questions highlight the need for tripartite stakeholder engagement and dialogue. Additionally, they highlight the confusion in the industry and the lack of opportunities for seafarers' organisations to share their voices with the regulatory body as a key stakeholder. The seafarers' organisations would like the IMO to reduce the uncertainty and have a calming influence on the industry.

> *"What is going on in the IMO?"*
> *"What is MASS?"*
> *"What is the way forward?"*
> *"How will this be handled in a proper way?"* (Interviewee 5)

Seafarers' representatives request the IMO in taking the lead to request flag states and ship owners to contribute towards greater awareness of what the future will hold. The seafarers' organisations and higher education institutions need to know what to prepare for to meet the demands of a volatile and uncertain future. Seafarers' organisations need clarity on how to operationalise the *'no one left behind'* concept. Seafarers are waiting for guidance on policy and regulations, among other issues and would like to tell the IMO and the national governments to not forget seafarers as the key human element.

Seafarers' representatives would like to tell the regulatory bodies and the shipping companies that they are not averse to technology. They seek cooperation and collaboration of all stakeholders and do not wish for the workers to be left behind.

> *"Cooperate with us. Trade unions are not negative to technological developments. We have dealt with this since the 1960s. The best solution is for smart ships with intelligent personnel on board. The political view most go hand-in-hand with the technical factor."* (Interviewee 1)

> *"Don't leave the people behind, those that need to take on the new positions, or the new work, or the new way the work will be done, and those that are completely blocked out of the jobs."* (Interviewee 10)

Interviewees see MASS as a positive development that can provide new opportunities, increase seafarer safety, and make a career at sea more attractive. This is pertinent as the decisions taken in the coming months and years impact seafarers decades down the line. Seafarers' representatives would like MASS to be developed for the benefit of the workers.

> *"There are a lot of opportunities with MASS to make shipping safer and to make the job more appealing to seafarers, and a lot safer for seafarers as well."* (Interviewee 2)

> *"The development of MASS should be for the safety of the crew, cargo, and the environment."* (Interviewee 15)

Additionally, seafarers' representatives would like clarity on unanswered questions regarding insurance coverage, accountability, and investment. According to the seafarers' representatives it is ironic that the industry is thinking of MASS while it is running out of competent seafarers at the same time. According to the seafarers' representatives, transparency and information sharing is important for stakeholder dialogue and cooperation on MASS.

> *"To make things easier, why not be transparent and talk about it."* (Interviewee 9)

> *"Please don't see the human as a cost…Please listen to our voice. Please be honest with us. We want to know what you're thinking about MASS. Don't hide the facts from the union. Be more transparent…I want to say to the government, and IMO, and the company that it's important to consider the potential impact of MASS on the environment and to take steps to minimise the impact. Please listen to the voice of the trade union. This includes reducing the emissions from the ship and protecting the marine life and preserving the sensitive coastal and oceanic ecosystem…MASS should be adapted in a way that benefits everyone and that the technology is used in a safe, responsible, and sustainable manner."* (Interviewee 13)

Investment in young people as maritime human resource capital would bode well for the future of the maritime industry. The seafarers' organisations would like the IMO to give clarity on the rapid development of the technological products and required related training. As per STCW resolution 15, a review should be conducted every 10 years. However, the last comprehensive review was conducted in 2010 nearly 13 years ago and the IMO would need to address this according to one interviewee.

The regulatory process at the IMO is time consuming. It would be beneficial if the regulatory environment moved parallel and kept pace with the next stages of MASS technological development. Maritime stakeholders need to collaborate and work together and not just push individual agendas. This is a global issue and needs to be tackled as one. Inclusive thinking and collective efforts are the need of the hour. Seafarers should get involved, be aware of what is happening in the industry, and should be willing to learn and equip themselves with training specific to MASS.

> *"Those people who took the right wind were on their way. You see the technology is coming, you need to find the right wind and you will be on the wave and then you surf. Same here, the seafarers need to keep abreast."* *(*Interviewee *12)*

6. SUMMARY

This section summarises the key findings of the research and presents the requirements of the largely unheard stakeholder group, the seafaring workforce – What do seafarers need?

Seafarers' organisations need tripartite stakeholder engagement and dialogue with transparent information sharing to keep pace with the developments in the MASS space to facilitate a fair transition for its seafarers. The seafarers' organisations would like collective discussions around policy and strategy where they can vocalise their concerns until the regulatory situation is resolved sufficiently. The regulatory landscape lags technological development. It can take over decades for regulation to be designed, ratified, implemented, and effectively enforced. Therefore, there is a need for enhanced stakeholder engagement to streamline the development of regulations in a timely manner. Seafarers' organisations need accessible communication channels to the key maritime stakeholders – the regulators and employers to help them jointly shape the road map for the development of MASS in their region.

> *"If decent work, well paid work for highly qualified seafarers is there in this industry for MASS operations, then we would want to be there and be part of it. We would like to shape those jobs and shape the working conditions under which one performs. No doubt, we will be at the table."* (Interviewee 14)

Seafarers' organisations want to prepare seafarers for a fair transition and want to support them in the fast-evolving industry through training and development. Seafarers' organisations need the IMO to undertake a comprehensive training gap analysis and revise the STCW 2010 Convention and Code, as amended and provide a completely new curriculum for MASS operations. Seafarers' organisations need guidance on the novel training modules, their duration, the required competencies to be developed, the manner of development, and their assessment. Seafarers' organisations need guidance from shipping companies/employers regarding their training requirements. With inputs from the regulator and the employers, seafarers' organisations would encourage seafarers to upskill and/or reskill so that they can compete in the future job market. Training and development of seafarers is an important need as it provides job security. Seafarers with updated training could either continue to remain employed as seafarers, or they could be absorbed in the ROC or elsewhere in the global logistics chain.

The seafarers' organisations want to highlight the difficult working conditions of the seafarers. The current situation is not ideal. Seafarers work unacceptably long hours and experience fatigue and health conditions due to the intensive nature of their work while at the same time being expected to practice good seamanship. The addition of technology on board has improved some aspects of the work and increased safety, however, at the same time it has led to a reduction in the number of crew and intensified their workload. The aim of any technology introduced on board should be to improve their working conditions.

According to the seafarers' organisations MASS needs more research in the area of training needs, competence development, regulations, technology, procedures, safety, cargo operations, energy efficiency, propulsion and manoeuvring, and navigation, among other areas. Cooperation, collaboration, information exchange, and sharing of research outcomes would help the industry achieve successful outcomes for all. The seafarers' organisations would benefit from labour specific forums for knowledge sharing of MASS concepts.

MASS is an evolutionary paradigm shift in shipping and not the ground-breaking solution to the challenges faced by the industry, in particular, the maritime workforce. In addition to the innumerable current challenges, any future challenges should not be overlooked. The current challenges facing seafarers are not necessarily MASS related.

> *"The existential threat is the same as it was 60 years ago – Health and Safety."* (Interviewee 2)

The seafarers' organisations want to share their challenges with the stakeholders so that they can get appropriate support in the concerned areas. The lists are not exhaustive and are compiled in alphabetical order under three categories, the current safety related challenges faced by seafarers (section 6.1); the future challenges facing seafarers' organisations (section 6.2); and policy considerations for MASS vessels (section 6.3). Noteworthy is that MASS by itself cannot provide the solutions for the challenges facing the maritime industry.

6.1 Current safety related challenges faced by seafarers

- Abandonment
- Access to shore leave, time off, work-life balance
- Anxiety around their future career in an advanced technological environment
- Armed robbery and piracy
- Breach of hours of work and rest requirements
- Challenging working and living conditions
- Criminalisation
- Culture of adjusting records for regulatory compliance
- Culture of limited trust on technology and systems due to prior experience of malfunctions
- Delay in payment of salaries
- Fatigue and mental health
- Fear of cyber-attack and lack of appropriate mitigation guidance
- Geo-political situations
- Heavy responsibilities and accountability, but with limited authority
- Impact of environmental protection measures on seafarers
- Immigration concerns related to visas
- Inadequate and insufficient appropriate onboard familiarisation

- Inadequate crewing
- Lack of awareness regarding enforcing seafarers' rights
- Lack of internet connectivity
- Lack of the provision of basic necessities and goods, such as fresh water
- Lack of uniformity in regulatory enforcement due to diverse interpretations in countries and regions
- Provision of appropriate and adequate education and training
- Provision of medical treatment
- Public health crises
- Repatriation and crew replacement
- Shortage of competent officers and job security
- Social isolation
- Uncertainty around future regulatory requirements
- Work intensification

6.2 Future challenges facing seafarers' organisations

- Adapting a new culture of interaction, in particular shipboard culture and smooth hand over
- Availability of competent and experienced instructors
- Connectivity loss due to malfunction of systems
- Crewing/manning requirements (sustainability of the maritime workforce)
- Education and training including curriculum development
- Emergency responses
- Evolving nature of work – Evolving roles & responsibilities
- Evolving seafarers' organisational membership
- Fear of cyber-attack and lack of appropriate mitigation guidance
- Focus on lower degrees of MASS and how it impacts seafarers and shipping
- Funding for training seafarers, including decarbonisation
- Intensified social isolation as experienced over the years
- Job security/Job losses – anxiety due to possible redundancies
- Regulations in place prior to operations – amendments in all related conventions such as SOLAS, STCW, MARPOL and MLC as well as associated instruments
- Timeliness of regulatory stewardship
- Transition plan for future employment and designations onboard and ashore

6.3 Policy considerations for MASS

- Certification and verification of MASS systems, including competencies of the workforce
- Cybersecurity mitigation guidance
- Decarbonisation measures and emission controls
- Emergency response and management at sea

- Hydrodynamics and impact on MASS operations, in particular adverse weather conditions
- Information transmission in compliance with the FAL Convention
- Maintenance and repair of the ship
- Mitigation measures in case of flag State's national jurisdiction and discrepancies with other nations' laws
- Overriding of command in emergency situations – Fire, blackout, etc.
- Policy on vessel construction and design, systems, and equipment (load line and stability considerations among other technical requirements)
- Port State Control inspections
- Practice of good seamanship
- Qualification of instructors and quality assurance measures
- Standardised safety regulations for novel technologies
- Wellbeing and welfare policies both ashore and aboard

6.4 Summing up

MASS is a novel evolving concept. It affords new opportunities to the maritime workforce and the industry and offers the promise of increasing safety and environmental sustainability.

> *"In terms of MASS let's make sure MASS delivers for seafarers, make sure it delivers a just transition from the skills they have now to the skills they will need to be part of the maritime vision. As I say with strong good jobs, with career prospects, decent salaries, opening opportunities for a diverse workforce and let's make sure that MASS delivers for seafarers in as much as it also delivers for the environment and for the operation of sustainable shipping."*
> (Interviewee 14)

7. CONCLUSION

The seafarer is largely the unheard invisible operator in shipping. This research project was conceptualised with the aim of collecting seafarers' voices for sharing with the industry and the regulators. This report considers seafarers as one of the key stakeholder groups and has presented a nuanced portrayal of seafarers' organisations and their concerns around MASS to fulfill its aim:

> *"To support the safe adoption and integration of new technology for ship operations and provide for consistency of approach to the design, build and operation of ships."*

The research findings have presented the evolving role and agency of the seafarers' organisations over the past decades. The research highlights the engagement of the seafarers' organisations with diverse stakeholders; what they would like to address to these stakeholders and their recommendations. The report highlights the diverse understandings of the concept of MASS in the industry. The presented timeline of MASS development differs from the earlier optimistic predictions of technology developers. The report also highlights the unequal development of MASS in the different world regions. The report includes the seafarers' organisations' tryst with technological evolution and their concerns and efforts around training and development of seafarers.

The research findings highlight the current and future needs of the seafarers' organisations. The current and future challenges, including policy considerations for MASS vessels highlight areas to be considered when developing the MASS code. The seafaring workforce should be included in all discussions that impact them. They need to be given access to avenues for tripartite discussions. The regulatory environment, seafarer/operator training and development, MASS vessel design and operations, cargo operations, seafarer health and safety and welfare, future crewing requirements, funding, data security etc. should be considered in the development of MASS regulations.

The education system is a conservative one with training programmes taking years to evolve. Similarly, regulations also take time to evolve and change. In an environment where regulations and training are slow to change, technology is fast paced. The harmonisation of technology, regulation, and training is challenging. However, inclusive stakeholder engagement is a step in the right direction to enable seafarers' voices to be heard and achieve a fair transition for the maritime workforce as seafarers are integral to the development of MASS.

APPENDICES

Appendix 1 – Interview 1 summary

KMI-ITF-KIMFT MASS Human Element Project

Views of the representatives of seafarers' organisations regarding Maritime Autonomous Surface Ships (MASS)

Interviewee details[26]:

Country	Background	Experience
Norway	Chief Engineer; Navy	Sailing – 15-16 yrs

Interview length: 1 hour 12 minutes

Experience: Extensive experience in worldwide/international oceangoing ships, Navy, and inland water vessels. Experience in the implementation of international regulations and national regulations and their enforcement as part of the national maritime administration – the Norwegian Maritime Authority. Interviewee has also served as the Port State Control officer.

Interview findings:

Definition of MASS:

"Unmanned ships that are operated by a computer."

The definition of MASS according to do interviewee focuses on MASS stage 4 when no humans would be present on board and the ship would be operated from the shore.

Timeline of MASS development:

(In connection with MASS stage 4)

"It will never happen."

The background context according to interviewee:

The development of MASS is largely driven by the ambitions of the technology providers and manufacturers. Furthermore, this development is a dream for the owners as it helps to reduce manpower on board, thereby reducing wage costs. MASS ship development started about 10 years ago it was believed that completely unmanned operations could be possible in the future. However, according to the interviewee, achieving unmanned vessel operations is next to impossible.

On Yarra Birkeland - The interviewee mentioned the Yarra Birkeland as an unmanned ship that would be solely operated by the computer. In reality there was crew present on board even within the trial area. Additionally, the vessel was also controlled from the shore-based remote-control centre. Even after a decade it was not possible to do what they had said they could do. According to the interviewee, there is no intelligence in the computer. The computer needs to be trained; all the data needs to be input with respect to navigation and operations. This is the reason why trial areas have been developed to train the computer. After several years it has been realised that the computer cannot be sufficiently trained.

[26] Some information has been withheld to protect the privacy of the interviewees.

"After many years, now they cannot train that stupid computer."

The difference between jargon and ground reality

The interviewee describes MASS as unmanned vessels of IMO stage 4. There is a tendency to go to the extreme stage 4 when MASS is mentioned.

"I don't talk about totally unmanned ships anymore." "Smart ship and intelligent people."

Navigation and operation

According to the interviewee, unmanned ships are a distant dream, and it would be sensible to speak of smart ships and intelligent personnel to operate the ships. The interviewee believes that navigation from point A to B is easy if everything is fine and there is good weather and no traffic. However, that may not be the case all the time. While navigation can be outsourced to the computer, ship operations cannot be outsourced. Competent personnel are required to operate these ships.

"We are not only thinking about navigation, we are thinking about operating a ship and especially in emergency situations, the computer can do nothing. We need competent personnel who know the characteristics of the energy they have stored on board and used."

Training, competence development, and recruitment for MASS ships

Additional training is recommended to serve on board the ultra-modern MASS ships.

"I strongly recommend we should have seafarers on-board who have the basic STCW training and if there were to serve on this type of remote-controlled ship then extra competence on top of that to serve on this type of ship."

The reason given is that in case of a fire on board, it needs to be put out and in the event of negative impact on the computers and other electronic systems,

"You need personnel on board the ship and take over the command and manually bring the ships safely to port."

the union would like to help the seafarers get ready for future ships. They want to enhance the safety for the seafarers. According to the interviewee, complex modern ships such as the dynamic positioning ships used in the North Sea is a MASS ship with a computer controlling the vessel. However, a competent person is always sitting there. In case something goes wrong, the person could manually take control. According to the interviewee, this is the crux of the whole thing as everything is okay when the weather is nice. However, in bad weather, ice, salt water, lithium-ion batteries, and air systems et cetera, anything can go wrong. Competent personnel are required on board in the event of fire and firefighting equipment is also needed on board.

Stakeholders mentioned by interviewee

The interviewee implies the following stakeholders with the use of the pronouns, 'they', 'them':

1. International Maritime Organisation
2. National government/ regulatory body
3. Shipping company

Union involvement in the development of IMO MASS instrument

The interviewee's union is involved in the development of the IMO MASS instrument.

Union involvement in government discussions to develop national MASS regulations

The interviewee's union is invited to the discussion table in the development of national MASS regulations, but the interviewee is also aware that some meetings can take place without their presence.

Direct communication with shipping companies and ship owners to develop MASS policy

The interviewee's union communicates directly with shipping companies and shipowners in the development of MASS policy.

According to the interviewee, the union has been invited from the beginning, however, some agreements have been without them. Robust stakeholder engagement will involve the national maritime authority, coastguard, shipping companies/owners, and the union. The union is in contact with all its members and shipping companies. Based on the feedback, official courses need to be developed to handle these types of ships. This helps the companies see the benefits of having the union as an ally.

Funding the training

"If you look at regulation today, you cannot operate a ship without personnel on board."

There is 99% agreement on which type of personnel should serve aboard which types of ships in Norway. However, there is no agreement with respect to payment for the extra competence needed to serve on MASS ships. The shipping companies would like the union or the government to pay for this additional training. Which entity can cover the cost of the training is still up for discussion.

Union and MASS policy

The union has a MASS policy. They would like to ensure that the STCW will safeguard their members in the future. They would like the seafarers get the right training under the lifelong training system. With the developments of new technology, new energy sources to power and propel ships, novel developments in manoeuvring and pollution prevention guidelines, the seafarers would need to be updated with lifelong and continuous training.

The union would like to address their requirements through the various IMO conventions – STCW and ISM; ILO MLC 2006 (2.6). The goals of non-emission and less crew on board cannot be undertaken without considering the safety for the Seafarer.

The union engages with other entities in Norway, the European Union, and Scandinavian member states. Stakeholder engagement is undertaken for the development of technical operations and regulations, including within specific industries such as the oil and gas. The union is interested in technical development along with the safety of the crew.

The Norwegian union participates in biannual meetings with Finland and Denmark. It participates in conferences with the head of the maritime authority; it is a member of the European Transport Workers' Federation (ETF); it participates in four meetings per year with the European commission and participates in funded research projects that include upskilling and the development of the right competence for the next 10 years. The union participates in tripartite engagement between the ship owner, workers, and the government. It is part of worldwide ITF policy development for 10 years now.

With respect to the manning policy due to the disruptions caused by the pandemic, the union stands for the rights of the seafarers to keep their jobs and be educated to serve on board new types of ships with new technology and new sources of energy. The union would like to serve the world in the future with competent personnel and has a regional, worldwide, and international presence.

"We all have the same sea."

IMO needs to address the following in connection with MASS ship regulations

1. Overriding of command in emergency situations – Fire, blackout,
2. Emergency management - Fire safety
3. Maintenance
4. Training and competence development
5. Adverse weather conditions
6. Emission controls
7. Standardised regulations for novel technologies
8. Interconnected nature of shipping requires stakeholders to work together
9. Vessel construction
10. Amendments in all related instruments – SOLAS, STCW, ISM, MARPOL etc.

With respect to the development of the IMO MASS instrument, in addition to training and competence development, vessel construction and characteristics of energy would need to be considered. The melting point of steel, flashpoint of stored energy onboard are extremely important to reduce exposure/danger and fire risk. With respect to the other related regulatory instruments, one needs to be mindful of what is moving out and what is coming in to take its place.

With respect to advancements in technology, the IMO has been focused on navigation and energy transition. However, no ships can be without personnel on board according to the interviewee. There will always be some crew on board required for maintenance. In the event of an emergency there should be provision to override the system and manoeuvre the ship manually. In any eventuality you need to have competent personnel on board for a safe journey. Blackouts are common and in the event of a blackout no computer systems are available. One needs to restart the whole system and even update software if required. The reliability of technology comes under question in such a situation. Emergencies can impact the computer system and we need competent personnel on board to manage the emergency and operate the ship safely.

The development of MASS ships is not as easy as they had thought about 5-6 years ago.

"They cannot see a ship unmanned totally."

Ship as a community

"You need to keep in mind that a ship is a whole community."

There are a lot of things that need to be taken care of on the ship – navigation, operation, ship stability, emergency management, environment protection, cargo storage et cetera.

Union in favour of technology for enhancing safety

The union is in favour of technology. They are not against the development of new technology. They like to see technology that can help the seafarers safely carry out their jobs. For instance, the union is in favour of the development of robots that could undertake the enclosed space entry as this could save a lot of lives.

On the one hand is technology, and on the other is the person who operates this technology.

"We say, never ever forget you need competent personnel on board to take over the command when the computer is down."

"The first rule is the safe return to port in which no life should be compromised."

"The technology is already present in some degrees on board ships and the seafarers are already familiar… My view is that intelligent personnel and smart ships."

A smart ship

According to the interviewee, an unmanned ship looks *'stupid'*.

"The smart ship is a ship with a lot of computers that can figure out the best route, the best rotation of the engine to save fuel, or the environment, and it will help you do everything, but today you need personnel on board who can take over the command."

Technological development

According to the interviewee, seafarers have been dealing with the development of technology since the 1960s. For example, the development of the radar that could be used to support navigation. According to the interviewee, when an equipment is to be placed on board a ship, one requires technical regulation as well as training for the equipment (generic and type-specific). There are divergences in the action taken by different countries. For example, some countries may go ahead with regulation development by starting research projects while others will lag. In some instances, seafarers will receive training before going on board, while in others they will go on board without the requisite training and could contact the union for support.

Perception of IMO

The interviewee believes that the IMO is the *'secretary for the ship's owner and the flag state'*. The ship owners are very friendly with the flag states as the latter are the administration that gives them the certificate of operation. Flag states want tonnage from the ship owners and speak in a friendly manner with them, and in turn have influence over the IMO by virtue of the tonnage they represent. The government and the ships' owners lobby to get mutually agreeable results. Everyone talks about safety, but when it comes to funding/money, safety could go down as a result.

Maritime organisation

The union is a maritime organisation as it is part of the system. The entire maritime ecosystem includes the IMO, National Maritime Administration, flag states, recognised organisations, shipowners, and maritime unions.

Regulations

Best practices and guidelines influence regulations/conventions. The regulatory landscape lags behind technological development. It can take up to 10-20 years for regulation to be designed, ratified, and implemented. There is a need for enhanced stakeholder engagement to streamline the development of regulations in a timely manner.

Trade unions and IMO meetings

Trade unions need to attend and speak out at IMO meetings. A good regulation may not be practised in the correct way. Unions could train themselves in the knowledge of regulations and their members with respect to the regulations pertaining to them. The unions need their voices to be heard.

Union and national government in relation to MASS ships

the national board governs vessels of 300-500 dwt. The government should enforce that all ships are under IMO regulations with some exceptions. With respect to safety, in principle all types of ships should come under the ISM code. The ISM code should be used for risk analysis to ensure that the safety is greater than or equal

to current ships with respect to MASS ships. The national law enforcing body should ensure that the ISM is well implemented. The inland water vessels would pose a real challenge as they do not come under any national regulations.

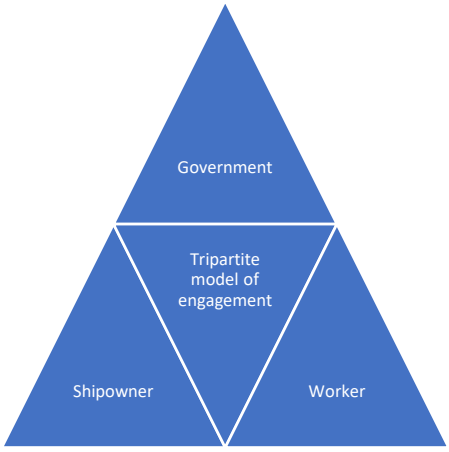
Even if a small ferry does not have crew on-board, the responsibility for fire and rescue would shift to the shore as there will always be personnel involved in emergency management and maintenance even if they have been moved to the background.

"So, whatever you do, you cannot say a ship is unmanned. It's not so easy as you think. You cannot take a ship and put it in the sea and say bye bye for the next 20 years. You fix yourself. It's not possible. Sorry."

There are SOLAS and non-SOLAS ships operating in national waters. The implementation of international regulation should be standardised for different ships and different industries in the country. International regulations should be flexible to be used inland with non-SOLAS ships. Each flag state can decide this for themselves. A tripartite system of engagement with the government, the ship owner, and the worker, utilising the ILO MLC (2006) can agree upon the different aspects and the exemptions. Ideally every ship should be under SOLAS.

In Norway, the unions have a voice and control. They see a common solution in which ships are manned in the future with the required competencies. They would like to see funding to educate the onboard personnel with requisite competencies as well as in the shore-based remote-control centre.

Figure 1: Tripartite model of engagement at National level



Recommendations

to summarise, the interviewee would like to make the following request to the IMO, the national government, and the shipping companies –

"Cooperate with us. Trade unions are not negative to technological developments. We have dealt with this since the 1960s. The best solution is for smart ships with intelligent personnel on board. The political view most go hand-in-hand with the technical factor."

Appendix 2 – Interview 2 summary

Interviewee details:

Country	Experience
Canada	Registered lobbyist

Interview length: 54 minutes

Interview findings:

There are 23,000 seafarers in Canada and the union's members are operating in Canadian domestic shipping.

View on MASS:

MASS is more than autonomous ships – "*more than just a ship that can move from point A to point B on its own without any human intervention*. Usually, the discourse on MASS focuses on autonomous ships but it means much more as it encapsulates the different degrees of evolution and autonomy. "*It varies from ship to ship and concept to concept and each one of those concepts impacts seafarers a lot differently*."
"MASS is a potentially disruptive technology" that will greatly impact seafarers. The focus of the union is largely on the lower degrees of MASS and how it impacts seafarers (members) and shipping itself.

Role and participation:

The union is part of the Maritime Safety Committee (MSC) with the ITF and participates in domestic conversations around MASS.

Timelines of MASS development:

MASS conversations largely revolve around autonomous vessels capable of independent decision making that are crew less. MASS is currently a developing concept and the degree 4 of MASS is the furthest away and least relevant to a lot of these conversations as few ships that operate with significant degrees of MASS.

Technology development and the union:

Technological evolution has always existed in shipping and the union has experience with this for over 40 years since the 1980s. Some operations are being performed on board with autonomous assistance/technology. This has led to crew decreases, new certification requirements, and new knowledge requirements for seafarers. With respect to ever increasing technology onboard, *"MASS as a concept is not really new, it's only new when you look at the later degrees and the more autonomous systems on board or the self-regulating vessels."*
Technology is a positive as it can make life easier and safer for seafarers: e.g., self-unloading vessel: remote control of winches from any position onboard the ship enhancing safety by removing the seafarer from the close proximity of the operation.
Unions support the seafarer trials of new technologies in the test beds being developed before the introduction of technologies onboard to see how the seafarers interact with this new technology.

Domestic shipping sector

In the Canadian domestic shipping sector, there are some ships with new fuel technologies and hull designs, however, ships haven't essentially changed a lot. Most ships are traditionally built as they need to fulfil a certain size

requirement to operate in the domestic waterways. The design and construction of vessels for domestic and international standards and operations vary.

Union involvement in IMO MASS instrument

The union is involved in the development of the IMO MASS instrument through its affiliation with the ITF. The interviewee is a member of ITF Maritime Safety Committee (MSC) and involved to a greater degree because of this. The union is also affiliated with a lot of bodies within the ITF. Therefore, even if it wasn't a part of the MSC, it would have been involved in IMO MASS instrument discussions.

The union and national MASS regulations/policy

The Canadian national government has the obligation to undertake consultations when developing new policy or regulations. The union is not specifically invited to participate in these discussions but participates as a maritime stakeholder in the public consultations. The proposed regulation is published in the Canada Gazette (public) and stakeholders can respond in the prescribed timelines. The union participates in the national forum for MASS which also brings together Transport Canada (maritime administration), and the National Research Council (NRC). In Canada tripartite conversations take place around MASS involving labour groups, industry, and academia. Conversations are led by the NRC where the research side leads the conversation rather than industry/technology developers. For example, NRC can focus on reduction in greenhouse gas emission and how will MASS fit into those conversations. Ship owners are involved in conversations as the end users of the technology.
A lot of conversations around MASS are forums led by people selling the technology.

"*So they have a skewed perspective on how quickly this is going to advance; on how great; or how positive or negative it's going to be*."

Technology providers cannot hijack the conversation in Canada as everyone has the opportunity to participate. The government does not want to spend excessively on technology; it's more concerned about emission reduction and having MASS fit into its goals rather than the other way around.
The Canadian government discusses regulations in parliament. It doesn't invite individual unions. It believes that if it consults the Canadian Labour Congress then it has consulted with the unions. CLC will include individual affiliates but not always and sometimes there will be an oversight and some unions will not get invited.

Agency of union

The union prioritises and pushes itself into conversations around MASS. The interviewee is a registered lobbyist for the last 5-6 years and has developed long standing relationships, including within the government. This helps them get invited for consultations. They have had high level conversations with ministers to have an idea of what's coming; what to expect; what the long-term plans are. In Canada conversations around MASS are tied to conversations around just transitions for workers and to emission reductions.

Union discussion with employers/shipping companies to develop MASS policy

The union is not discussing the development of MASS policy with shipping companies to the degree it should be. The domestic fleet in Canada is fairly a new fleet. A lot of new technologies are retrofitted onto ships over time with the implementation of more digitalisation, autonomous systems etc. The union has not had extended conversations with shipping companies regarding what would happen in 10 years' time when they bring

in extensive autonomous technology onboard. The union believes that they need to start having this conversation in the next 4-5 years.

Union and MASS policy

The union has been dealing with technology related issues for years now, however, no official policy on MASS.

Union engagement with other entities

The union interacts with different entities in the Canadian Forum for MASS. It is affiliated with the ITF. Involved with the IMO through ILO MLC. The union is not directly involved in other forums in other countries; however, they maintain an oversight. For instance, the union works with the ratings union, and the officers and engineers' union in Norway to learn from them. Some unions in other countries such as Norway are further along. *"What they are seeing today, we may see in 2-3 years, so it gives us some insight into what to expect."* Developments in Norway can have a similar impact on Canada with respect to technologies considered onboard, and the impact on membership. The Canadian union learns from its sister union operating in America.

Collaboration forums

No official forums for collaboration as such. The union engages with other entities in an ad-hoc manner through conversations and through the meetings (including IMO meetings), and conferences they attend. Extensive technical information is available within MSC which they share as much as possible via email. The union shares most information with the ITF. It would be helpful for us to set up a labour specific forum for sharing MASS concepts and discussions for knowledge sharing. The MASS forum in Canada is important to hear seafarers' voice.

Future role of the seafarer

Overarching theme that needs to be unpacked. How does the human element fit into conversations of MASS and its impact on seafarers? Modern ships are operating under a certain degree of MASS. Stakeholders need to ensure necessary training/qualifications for personnel to be holding these positions.

"We don't want necessarily outside noncertified personnel on board operating a ship who don't have the necessary competencies and qualifications to be there."

STCW competencies are paramount for onboard operations and ideally remote-control centre operators should be qualified under the STCW convention. Regulations should be put in place before operations.

Technology should not outpace training

Currently training doesn't exist for ships coming into Canada with new fuel technologies. Training is being developed to keep up with technological developments. This is not safe due to oversight issues. There is a lack of understanding regarding how the technology works and there are no lessons learned. All the lessons learned come from fatalities or injuries to seafarers that weren't properly trained in this new technology. Industry needs to keep pace with what's being done.

ILO – MLC definition of seafarers and employees other than seafarers onboard

The union does not have specific views on the ILO-MLC definition of seafarers and other onboard employees. Anyone working on the vessel is considered a seafarer under the collective agreement.

Issues to be addressed regarding policy

1. Safety of seafarers
2. Seafarer training
3. Seafarers to be made aware of transitions so they can plan for them.

Seafarer shortage and future recruitment

The union's greatest effort is towards job retention.

"We have a shortage of seafarers globally… what we don't want to do is make some seafarers redundant to the point where they leave the industry and then you need a whole new batch of people coming in with new knowledge. What we should be doing is taking those seafarers whose jobs are potentially at risk to a certain degree and providing them with opportunities to take new training to learn new skills, to learn new competences, to have the certifications that the ships of the future are going to need."

"Positions on board will always exist; there may be a reduction in the number of people on board in those positions. We need to transition those personnel into new roles or new positions on board. You don't want to lose a qualified workforce and then have to retrain from scratch someone new to occupy a position on board that maybe has to do with information technology or something."

Ship owners will lose crew; we will lose members; it's not a good scenario; needs to be avoided"

Complications with different/multiple jurisdictions

In case there is a mixed nationality crew onboard a ship registered in one flag state and a remote-control centre in another country. The labour laws of which country will be applicable? This huge concept needs addressing. Onboard a ship is the flag jurisdiction and ILO MLC whereas workers in the remote-control centres will be bound by different hours of work regulation. The legality of these underlying issues will need to be addressed before operations.

Union and shipping companies/owners

1. Demand and supply – Overarching dialogue about training and recruitment. Where do we find seafarers at the moment (shortage of seafarers)?
2. Most conversations about immediate need; not so much looking at long-term.
3. Not specifically focused on MASS; focused on current labour needs.
4. Potentially coming but requires huge capital investment and transition.
5. (Lack of) Availability of adequate and suitably trained staff in office (superintendents, technical managers etc.).
6. Willingness of engaging with MASS at this point in time - Not necessarily looking at a significant change in new fleet design or new tonnage.

"We often look too far down the line. We're looking at the end goal where a lot of ship owners right now this is not on the radar; they're not talking about it, so, we're not talking about it. We're all going to have to at some point potentially but, this is what happens; the technologies are there, the ideas are there but if it costs a lot of money, if it takes a lot of time, it's not a priority at the moment. The priority for our ship owners anyway is for securing contracts and ensuring a healthy bottom line."

Recommendations to IMO, government, and employers

To ensure labour involvement in conversations. *"What we don't want to see is an advancement of all these conversations that don't consider the worker."*

Stakeholder dialogue and engagement

Ideally the stakeholders should have begun conversations on the impact of autonomous technology on the human element, earlier. The union advocates for joint decision making with seafarers' welfare and safety taken into consideration in every decision. Need to jointly talk about technology and its impact on the seafarer, evolving ship design and cost considerations.

"We tend to talk in silos, it's not good for everyone. Everyone needs to be at the same table. I think that's the most important thing."

"We can't wait to have these conversations… At this point everyone needs to be at the table having these conversations so that we are all prepared, and whether that happens quickly or whether that happens over decades at this point, which I think is most likely, it's good."

Impacts of MASS:

"If you talk about really advanced autonomous shipping and you're talking about removing seafarers, you'd be eliminating millions of jobs around the world. Not just jobs on ships but spinoff jobs."

One needs to understand the impact on social programmes in different countries where they are paying taxes; the impact on society; tax revenue to the government. There are diverse big concepts that are all related to mass and need to be understood in depth.

1. Redundancies – *"We're going to turn this into a positive. We're going to make sure that nobody gets left behind or as few people get left behind as possible."*
2. MASS is evolutionary.
3. Technical – Safety; Ease of operation
4. No specific MASS training available currently
5. Upskill - compensated on taking time off to advance training – work into contract
6. Seafarers are making good money currently – salary review of expectations if seafarers need to be more qualified; more highly trained – need to be compensated accordingly.
7. Review recruitment, training, and scheduling, among others for a whole different generation of seafarers.
8. Upgrade their working and living conditions as the job is not good enough to invest 2-3 months away from home.
9. Workforce qualifications – IT, computers etc. in addition to STCW

Current challenges seafarers are facing:

Challenges are not necessarily MASS related – *"Existential threat same as it was 60 years ago – Health and Safety."*

1. Safety
2. Fatality, injury
3. Covid-19 pandemic
4. Shore leave
5. Repatriation (Qualified workforce in adequate numbers)

6. Appropriate and adequate training
7. Work-Life balance
8. Time off
9. Fatigue - Adequate rest

Anything to add!

ITF gathering voices from seafarers' unions around the world to present to IMO is a positive step in making the seafarers heard in the international forum.

"There are a lot of opportunities with MASS to make shipping safer and to make the job more appealing to seafarers, and a lot safer for seafarers as well."

Appendix 3 – Interview 3 summary

Interviewee details:

Country	Background	Experience
Iran	Marine Chief Engineer Competency (unlimited); Marine Superintendent & In charge of control & supervisor of Navigation & Electronic system automation Equipment; Doctoral researcher	Sailing (super tanker) – 8 yrs; Superintendent experience; IMO meetings; ITF MSC experience

Interview length: 1 hour 19 minutes

Experience: Extensive experience in the maritime industry comprising sailing, including as Marine Engineer, Planned Maintenance engineer, superintendent, union leadership, and doctoral student.

Interview findings:

The interviewee is highly experienced and familiar with the implementation of international maritime regulations at the national level down to the company level.

Sanctions against Iran:

Due to the sanctions against the country, the situation in the country has changed and is not regarded as normal. They try to follow and do as much as possible, however, do not have the luxury to go for innovation and/or new technology as they are under sanctions. According to the respondent, Iran has good students, universities, technical know-how, and qualified personnel. They have the potential to evolve and are interested in progress, however due to the sanctions, their speed has been significantly reduced, however has not stopped entirely. They were one of the countries that designed and submitted a water ballast management system for approval. While the other countries that had submitted designs were resource rich maritime nations, Iran was a developing country to do so despite being under heavy sanctions. As of now up to 25 PhD students in Iran are focusing on topics related to MASS, which include regulations, collision avoidance, and communication among others. There are several famous scientists from Iran who are serving in the Silicon Valley in the United States. They have good human resources, however, are facing a challenging situation due to the sanctions. They also experience Internet problems that impact their work. They don't give up and keep pushing to forge ahead despite the challenges. Their quality human resource can contribute to technical and other matters related to MASS. According to the respondent, MASS is a new industry and even if the country cannot contribute to it in a manufacturing/ producing capacity, it can study it and about 10 subject areas pertaining to MASS are being studied in the Iranian university. Some of the challenges to MASS are cybersecurity, regulations, jurisdiction, Remote control centres, Vessel Traffic Service (VTS), and accountability in case of an accident between a MASS vessel and a Non-MASS vessel. Iran has faced cyberattacks from outside. Due to the sanctions, the environment is difficult, and it becomes challenging to implement new technology, new regulations and instruments. The sanctions in the country affect everything including MASS.

View of MASS:

The respondent differentiates between automation and autonomous. the former is an automation of a process without human involvement, while the latter is independent/

autonomous satisfactory performance - it is the ability to satisfactorily perform independently without external intervention. The plan for the development of MASS should be compatible with the digitalisation process. the developments in blockchain technology, Internet of Things (IoT) etc it should be aligned and adjusted to be suitable for realising MASS. MASS is not just a floating ship that can make decisions by itself. It is much more complex and has a range of interrelated issues. MASS provides opportunities for the country in terms of training and with respect to the infrastructure to host these ships. A country which is not ready with respect to the training of seafarers/operators for these advanced ships, and does not have the infrastructure to support MASS, will lose out and it is dangerous for them. This is an area of worry/concern and seafarers are worried that they will lose jobs as these new operations would require new skills. the countries which are prepared for the transition to MASS will emerge as winners.

Union involvement in the development of IMO MASS instrument

The union is not involved in the development of the IMO MASS instrument. The union is interested in MASS, however, currently the industry in Iran does not have the potential to develop the physical products in connection with MASS. The IMO has a road map to examine the MASS non-mandatory code in 2026. The respondent would like to communicate to the IMO to integrate the technical part of the seafarers' unions as part of the process. The respondent would like the IMO to consider two levels of development in connection with MASS. Autonomous vessel operations require good technology, finances, and readiness of the industry. If developing countries do not have the infrastructure to receive such vessels, we could have a situation where MASS vessels only sail in Northern Europe. The respondent believes that the unions should be a major part of the discussions around MASS. They should be given time and support to develop MASS at the same speed as elsewhere in the world. this would help to facilitate MASS operations in the whole world. The respondent provides the example of the new fuel technologies which are not prevalent in all parts of the world. The IMO would need to determine whether four years of implementation of the voluntary code Is good enough for MASS or not. There is a cross cutting agenda and overlapping safety and environmental issues. All decisions should be taken to protect human lives and the environment together. According to the respondent there is a difference when trade unions speak on behalf of the membership and when the national governments address the IMO while representing the member state. The trade unions represent the people, the human resources, their safety, and everything concerning them, Whereas the government is more concerned about the financials. According to the respondent tripartite discussions on MASS are extremely important as they would involve the three major stakeholders - the government, the employer, and the employee. The ITF has a good overarching view at the international level, therefore should represent union's views, whereas the respondent's union would have local views, concerning the country and the immediate Middle East region. The respondent would like an area designated for Iranian activity in the MASS project. This could be on land/island belonging to Iran. This proposed activity should be undertaken through international actors such as the ITF, ILO, and the IMO and should ignore politics/inter-government relations. Non-governmental actors such as unions and universities in Iran can come together to help in this facility. This would help train Iranian human resources and permit student exchange, among others to facilitate MASS in the region.

Union involvement in the development of national MASS policy

From 2019 onwards the union has been involved in discussions pertaining to MASS. The respondent has sent 5 letters to the Prime Minister's office and to the administration of Iran. They have also had discussions on television related to MASS. The union has recommended to the national government the need to have one working group for MASS

at the national level that could provide regular updates every three to four months in connection with developments in MASS/autonomous systems. The respondent and the union are involved and would be invited in any discussions at the national level in the future. Documents related to MASS are sent to him by the national government for his comments and notes. The union actively remains in front of the government and if the government would like to follow MASS, they would ask for the respondent and the union to get involved. According to the respondent, for the Iranian government, the training of the human resources for MASS and the development of the infrastructure/port facilities are very important. The country needs to prepare itself to be able to receive MASS ships. According to the respondent, the lack of port infrastructure will affect seafarers. For example, the planned maintenance jobs of vessels need to be done efficiently and effectively when they are in the port facility, however, if the local facility cannot support this the vessel would need to wait for a long time. There would be pressure on the crew on board when there is no good facility to support them. There are challenges in connection with Search and Rescue (SAR) between autonomous and non-autonomous vessels; when no guidelines are given and there are no instructors, how would they handle these requests. The regulatory aspect of MASS is challenging. If an autonomous vessel has an accident with a non-autonomous one, or if two autonomous vessels have an accident in international waters, who would be responsible for going to the site, checking, and evaluating! Port facility encompasses everything for the shore side facility; better communications, better Internet connectivity, port infrastructure, hardware, software, cyber security, Internet of Things (IoT) are needed for MASS. We need to think in depth about the port facility in terms of safety, security, and environmental protection issues. MASS is a huge project to realise. Iran needs reliable communications and support to make progress with MASS.

Communication

Iran has 7 layers of Open Systems Intercommunication (OSI) Internet security and control. These layers can serve as barriers to undertake seamless communications. In some instances, VPNs need to be used to communicate which may or may not be working on certain occasions. When seafarers visit Iranian ports, they have several ways of sending messages and communicating with their friends and families, which are not necessarily through the Internet. They give a brochure to the seafarers to educate them about communication. Through an ITF project, Iran has offered psychological support to the seafarers and Internet for their connectivity. About 10,000 SIM cards were distributed to foreign seafarers. According to the respondent connectivity for seafarers is not a big issue now and they have better conditions compared to the others in the country.

Union involvement with employers/shipping companies to develop MASS policy

Currently the union is not involved in the development of MASS policy with employers in the shipping industry. Due to the sanctions on the country, the companies are not currently embracing innovation. However, when things become normal in the future the union would like to discuss MASS with the companies. In 2010, NITC was a famous tanker company occupying 4th-5th position in the world. It was the youngest company, however due to the sanctions, it has lost its position. In Iran, the development of MASS has been heavily impacted by the political and economic sanctions and the current situation of the country. The respondent cites the example of the Water Ballast Management System in which they liaised with the shipping companies and the government to go for systems in line with safety, environmental sustainability, and finance considerations. The respondent would like to tell the shipping companies that MASS can provide a great opportunity to the industry. Ship owners can make more money if they invest in safety. They should consider

adopting novel technologies to reduce their costs overtime and be competitive. Ship owners should invest in training their human resources in the new skills required.

Union and MASS policy

The respondent differentiates between policy for the development of MASS, and policy for the planning for the future of MASS and using MASS. The union has a step by step over arching plan and strategy for the development of MASS. The union is interested in the experiences of adopting MASS, including its challenges at the international level. The union does not have a MASS policy in connection with using MASS. If they get more clarity on how to run MASS, then they can go about it. As of now there are no autonomous vessels in the Persian Gulf or large parts of Asia. The respondent notes that NYK in Japan is working on autonomous ships. However, autonomous vessels will gain general popularity after 2028 when the testing and examining autonomous craft as highlighted in MSC 130 will be completed. The work of the trade union in connection to MASS goes beyond coming to agreements, securing job and financial security, and social benefits for its members. The union has a plan for the future in line with its philosophy and mission. The union would like a MASS CBA - Collective Bargaining Agreement specific to MASS. For the union, the safety, human resources, training, and skill development are extremely important in connection with MASS.

Union engagement with other entities in connection with MASS

The union has not interacted with any other entities in connection with MASS, however it would like to do so in the future.

Recommendations

The respondent would like to communicate the pure voice of the Iranian seafarers to the world.

To the IMO

- Reflect upon two levels of MASS for countries – developed and developing.
- Creation of apolitical safe area in Iran for MASS development.
    - Work carried out through non-state actors, unions and universities in Iran.
        - Utilisation of Iranian human resources

To the Iranian government

- Creation of a national working group to guide the development of MASS.
- Creating and being part of a regional group in the Middle East/Persian Gulf in connection with MASS

To the shipping companies

“If you need a market, you need to be prepared for the new technology, otherwise you stand to lose everything.”

Appendix 4 – Interview 4 summary

Interviewee details:

Country	Experience
Bangladesh	Seafaring experience; Command experience; Marine consultancy experience; Union experience; IMO experience; ITF sub/committee experience

Interview length: 44:04 minutes

Interview findings:

Introduction and experience:

The respondent is the representative of his union in the ITF. He is a member of the ITF MSC and the STC and CCC sub-committees. He is an ITF expert in the IMO on the CCC sub-committee. His seafaring career spans 13 years. He sailed between 1976-1989 when shipping was significantly different than today. There was no automation, no GPS and satellite navigation was coming up. There were not many electronic systems onboard. The ship's position was arrived at with the aid of celestial navigation. Ship navigation was different four decades ago when the respondent sailed. The RADAR had just been introduced; there was no ECDIS, and ARPA was coming up.

Union interaction with membership:

The executive committee of the union and the governing body meet every 2-3 months to discuss issues of importance. The Annual General Meeting (AGM) of the union is open to the members where they can annually participate, interact, and express their opinions. Due to COVID-19, the union meetings moved online. Email groups have been created for the managing committee members and union membership. The reports finalised in the executive committee group are circulated to the members via email and other channels. The union is utilising social media such as Facebook to reach out to its members. A key role of the union is to create channels of communication to reach out, connect, and disseminate knowledge, ideas, and pertinent decisions. The union strives to keep its members updated on national and international issues, seafaring matters, facts, and knowledge useful to them. The hybrid mode of conducting AGM supports union members who are working onboard ships. They can connect if the timing is suitable for them.

Internet connectivity, communication, and union membership:

The interaction between the ship and the shore will continue to increase with higher degrees of MASS. The union utilizes the communication tool WhatsApp to achieve connectivity during meetings. The internet connection needs to be robust to provide a seamless experience. Currently, the connectivity depends upon the distance from the shore. The quality of ship communications is not great at all times. It is not of a high quality, but it works. Depending upon the quality of the internet ashore and onboard the union aims to achieve connectivity. According to the respondent, the meetings conducted in the hybrid mode may not be very interactive but are informative. Added to this is the challenge of the limited time available to the seafarers for using the internet onboard. At times the internet usage onboard could be restricted to a few minutes which would pose challenges for a host of issues such as remaining connected to family and friends, undertaking any online education and training, among others.

View on MASS:

The respondent highlights the 4 stages of MASS given by the IMO. The respondent's knowledge and understanding of MASS is shaped by the books, magazines, and articles that have been coming out in the media. He notes that the regulatory body has been working on it, however, IMO proceedings are limited in this area. The respondent hasn't yet found/spoken to anyone who has personal experience of MASS. According to the respondent, MASS is not a big issue to the company, individual seafarers, or the national government at present. The stakeholders in the respondent's country are happy with the present level of automation, maintenance, and communications onboard. Operating an unmanned ship is not yet in the culture even within the maritime industry. Dynamic Positioning ships have high levels of technology. However, the respondent hasn't obtained the direct opinion of anyone who has served on a MASS ship. According to the respondent, everything is theoretical at the moment. The respondent notes the appreciation for developments in IT, however the industry lacks the appreciation of higher degrees of MASS ships. There is a huge gap between the envisioning of MASS and its uptake. The discussions and engagements on social media do not centre around MASS but rather on other pressing issues such as decarbonisation, green power/fuel, fuel systems, wind power, seafarers' welfare. A big issue in Bangladesh is seafarers' welfare. Seafarers' rights and issues are being addressed through the union and the government in Bangladesh. MASS comes across as a niche area which is far from reality.

MASS and regional considerations:

Affordability of MASS comes into the equation for geographical regions. If all regions could afford it, then there would be similar developments taking place in the different world regions. MASS is not only limited to the vessel itself but the entire ecosystem of infrastructure to support its development. The European Economic Community, Denmark, Norway and Sweden are more involved in MASS. MASS is not being taken up in a significant way in South/Southeast Asia. It is an important area that needs to be discussed by the seafarers and the industry ashore. MASS is suitable for short run trading for instance in the Baltic Sea, therefore, it is more suitable for Scandinavian countries. MASS is not suitable for a ship crossing the Atlantic or the Pacific in autonomous mode. Bangladesh has a network of rivers, and the sea routes are far off. Additionally, the rivers/seas are very rough in the Bay of Bengal and more so during the monsoons. The seas are rough for seven months in the Bay of Bengal. Therefore, deriving the benefit of a short route is not available in the region. In the future there could be a possibility of trying a medium route between Bangladesh, India, and Myanmar. Success of MASS depends upon several factors that include the geographical and route considerations. Countries in Asia, such as Indonesia, Malaysia, Singapore, Hong Kong-China, can explore the benefits of MASS. In Southeast Asia, the proximity of Japan and Korea would help deploy MASS. Along the China coastline, MASS can be explored. If the success case can be proven for the short and medium route, then longer routes can be explored. MASS is suitable for small ships, in resource rich regions where the seas are not rough. Suitability of MASS and its success depends upon the routes, geographical characteristics of the region, infrastructure readiness/availability, market dynamics, financial, and human resources.

"I think it's going to take a long time until everyone is happy with the short trade route of MASS."

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument.

The union and national MASS regulations/policy:

In case any national MASS regulations are being developed, the union would be consulted. However, there are no appreciable activities in connection with MASS within the private sector, the public sector, or the government, in Bangladesh. The government and the shipping industry are not much aware of the ongoing developments in MASS. The national government accommodates the union's voices. The union is invited as a stakeholder to the government's discussion table on issues pertaining to the ILO MLC, Seafarers' welfare, training, and administration. The union is part of the maritime council which represents all sectors of the maritime industry. If the conversation around MASS starts in Bangladesh, the union would like to put the proposal forward to change the membership criteria to update it as the industry changes. The union would like the government to recognise its responsiveness in addressing MASS in addition to other seafarer' issues. The union would like to be involved in all discussions pertaining to automation and MASS in Bangladesh.

Union and MASS policy:

The union does not have a MASS policy.

Union discussion with employers/shipping companies to develop MASS policy:

The union has not discussed MASS with employers as it is not currently looked at as an important issue. Once discussions start with employers, the union would like to understand their scope and intention. The union keeps its eyes and ears open to *go with the industry as it changes to protect the seafarers' interests and their jobs*. The union would like to train its members so that they can be employed in the changing industry. The union would like to discuss the operational and manning requirements directly with the ship owners so they can support their members with their employment.

Union engagement with other entities on MASS:

The union has not engaged with other entities in connection to MASS. There is no cooperation in this area yet.

Address to the IMO:

The seafarers' involvement in MASS needs to be addressed comprehensively – how far will they be involved. Education and training would need to go up according to the requirements of the degree of MASS. A new curriculum would need to be designed and the STCW would need to be revised. The ITF will play a big role in helping understand the seafarers' involvement in MASS vessels. Several points need to be understood in connection with seafarers' and MASS.

1. Future operations – Will they take place at sea or ashore. Correspondingly what roles will the seafarers take on! What jobs can they apply for in the new environment!
2. Training pertaining to the roles in future operations.
3. Understanding and developing levels of the seafarer/operator involvement corresponding to degrees of MASS.
4. Clarification of the roles, responsibilities, training, manning levels, and scale of operations.

Tripartite communications required between the stakeholders – the flag, industry, seafarers' bodies to understand the level of manning and the competence and qualifications of seafarers. The remote-control operator need not be a seafarer. The Air

Traffic Controller does not fly a plane; therefore, non-seafarers can work in controlling MASS.

Union membership and MASS:

Trade union membership will lose if the union only focuses on seafarers. They would need to extend the membership to non-seafarers to involve other categories of workers in the maritime ecosystem – MASS traffic control, dockworkers etc. This is an opportunity to take other workers working in the same industry onboard.

Final thoughts/recommendations:

"The seafarers are ready. The union will be ready. We are getting prepared so there's no shock or surprise."

"Our approach is open. If the nation, industry, and trade think that using autonomous MASS ships will benefit international trade and the country economically and socially, we'll accept it as it has been accepted in the industry. As a stakeholder we'll encourage it. At the same time, with the changes, our seafarers must change and must take part to not miss any opportunity presented by autonomous shipping."

Appendix 5 – Interview 5 summary

Interviewee details:

Country	Experience
Sweden	Union negotiation experience; MEPC expert, MSC member; Seafaring experience

Interview length: 38:05 minutes

Interview findings:

Introduction and background/experience:

The respondent has experience as a union negotiator for 5 years. He is an MEPC expert and a permanent representative of the country in the IMO. He is also the member of the Maritime Safety Committee (MSC). He has seafaring experience. He has sailed as a nautical officer on board Ro-Ro and Ro-pax ships. He has sailed as a master in the Baltic Sea region. He has over 10 years of sailing experience. Subsequent to which he went to university and got a shore job in the office.

View on MASS:

"We can't stop this."

MASS is the first step towards unmanned ships. There are differences between Sweden and its neighbouring country, Norway when it comes to MASS. Norway is at the forefront of undertaking work on MASS ships and Yarra Birkeland is a case in point. Norway has a bigger merchant fleet than Sweden and has more schools to educate officers. Sweden has about 100 vessels and Norway has much more than that. A large number of discussions in Norway centre around MASS. Several Swedish students get jobs in Norway, and it is important from the point of view of future job security. According to the respondent, an unmanned vessel in the middle of the Atlantic is not ideal for environmental protection.

Timelines of MASS development:

The respondent does not see unmanned ships in the near future. From a practical point of view, a lot of things need to be handled before MASS can happen. As a union, they cannot stop the advent of MASS but can help to regulate aspects of it. There are several legal issues that need to be considered and questions of insurance that need to be addressed among others before MASS can become a reality. There are no quick fixes. A lot needs to be addressed in connection with FAL Before anything else can be done.

Union and MASS training:

There is no clarity on the number of people needed to work onboard and ashore in the future. There is extremely limited understanding of the kind of training they would need. The people sailing onboard today would need to handle the ship from the shore. The education, certification, and competence would need to be in place before the advent of MASS. The technical plus social plus legal plus safety issues would all need to be considered before MASS becomes a reality.

Union involvement in IMO MASS instrument:

The union is involved via the ITF in the development of the IMO MASS Instrument.

The union and national MASS regulations/policy:

The union is always invited to the government's discussion table on national MASS policy/regulations. Before an IMO meeting, the union is invited by the government for discussions regarding inputs to the different committees in the IMO. They discuss the Swedish stance alongside the European union's position on questions in all types of committees. The union would like to talk to their government regarding how MASS affects its members.

Union and MASS policy:

The union does not have a MASS policy. The union is active in ITF MSC but not directly a part of the MASS instrument committee. The respondent has been addressing various issues such as the human element, training, responsibilities, environment, and safety through the ITF MSC.

Union discussion with employers/shipping companies to develop MASS policy:

The union does not discuss MASS with employers, ship owners, and shipping companies. The union would like to ask the shipowners and shipping companies if MASS is the way they want to handle the future! If unmanned vessels are the way forward! In such a scenario, there won't be enough people for them to hire. They would need to try and find and educate people. Some companies are hiring retired officers in Sweden. Unemployment is not relevant in the developed country and people may find work in other sectors. In connection with MASS, the country does not have any person with the suitable certificate who can be hired. The sustainable operation of the industry is challenging as it is difficult to find the right human resources with the appropriate training.

Union engagement with other entities in connection with MASS:

The union engages with the European Commission for regional cooperation. With respect to the future of education and training some developments are underway and will be shared shortly. These are the outcome of meetings at the European Union level with the Swedish transport. The universities have raised the question they have not heard anything about progress on MASS and/or the future of maritime education and training.

Final thoughts/recommendations:

The industry has several questions such as, "What is going on in the IMO?" and everyone is waiting for some clarification in connection with MASS. *"What is MASS?"; "What is the way forward?"; "How will this be handled in a proper way?"*

People are waiting for guidance on policy and regulations, among other issues. The respondent would like to tell the IMO and the government to not forget the human element, the training and the watchkeeping. We are seeing issues with seafarers psychological and psychosocial health on board want to support them.

"The regulations, both international and national need to be in place before the implementation of MASS."

There are unanswered questions regarding insurance; *"Who is going to pay for what?"*. According to the respondent we are running out of competent seafarers now but at the same time are thinking of MASS.

Appendix 6 – Interview 6 summary

Interviewee details:

Country	Experience
United Kingdom	Seafaring experience; Union experience; IMO meetings experience; ITF MSC steering committee experience

Interview length: 52:12 minutes

Interview findings:

Introduction and experience:

The respondent attends the IMO meetings on behalf of the International Federation of Shipmasters. He's a member of the ITF MSC steering group and is a former deck officer. The respondent has been involved with the IMO in connection with MASS from the very beginning. He has been with the trade union for over 10 years.

Changes over the past decade as a trade unionist:

The respondent notes that over the past decade environmental issues are being taken more seriously. The respondent also notes that previously entities were not as collaborative as there were tensions between them.

"I can't imagine the Human Element Industry Group 10 years ago. I wouldn't have imagined the ITF and the ICS sitting together meeting outside of IMO meetings and working towards a common cause."

The maritime policy in the UK and the EC:

Nationally in the UK over a decade ago there was a period of industrial strife. The United Kingdom government's maritime policy has seen an improvement over the last decade. Previously there was a religious zeal to cut regulation in line with its extreme free market ideology as all regulations were considered bad. The same is not true anymore. Presently there is a coherent maritime policy that is inclusive of seafarers. The current goal is to increase UK seafarers and improve the training standards. A reduction in the number of hours worked on board is in line with safety goals.

"I can't imagine it being government policy 10 years ago."

Previously The United Kingdom has lobbied on fatigue and safety, however, were unable to follow through as fatigue was a European Union competency area. They tried to submit a paper on fatigue, however, were overruled by the Commission. With Brexit, the United Kingdom has an opportunity to follow through and to be seen to be doing things they had previously said they couldn't because of ties to the European Union.

The legislation that the United Kingdom has put in place in connection with MASS concerns test areas which is not controversial. There has been no change in the law yet to enable MASS.

View on MASS:

MASS for the respondent is increased automation and systems involving more complex technology.

"On the face of it, it needs less interaction from seafarers, but will also actually require a much higher level of training and skills from seafarers who are using it."

"Automated systems that would require less input from an operator."

IMO and MASS

According to the respondent, the IMO's focus on ship types is unhelpful as the focus should have been on systems. It's unhelpful to define ships as MASS or no MASS as one needs to understand where the ship is, what it's doing, and how many people are on board among other considerations. The class of the ship and its assessment as a whole system that comprises automated cargo planning systems, mooring systems etc is helpful. The ship should be seen as comprising all integrated systems and not as MASS or no MASS categories. Things are moved along since the IMO's work on MASS in 2019.

"The IMO was pushed into it by the hype around autonomous systems and then they found themselves down the road where they were trying to regulate something that didn't exist yet, which is not normally the way of doing things. Normally, the safety case is proven and then proposals are made to regulate new systems that have come into operation; not trying to develop regulations for something that no one knows what it is."

With respect to the four stages of MASS, the IMO presumed that companies would build a ship that would match the stage, for example a stage 4 ship, however the reality is different. Ships could have different artificial intelligence systems such as decision enhancement systems, collision avoidance systems which are automated and were not previously. This would not make it a MASS ship. The respondent has toured a UK based company of offshore vessels which they plan to operate in an autonomous unmanned mode at some point in the future. Currently it has a full crew onboard. The respondent notes that the vessel will be operated in a manned and unmanned mode according to the requirements at a particular given time and it would be impossible to regulate in such a scenario. The respondent questions the feasibility/applicability of the regulatory environment in flexible operation scenarios. Currently the whole regulatory regime applies and if you have technology onboard you have to prove that it does the job equally well or better. The applicability/feasibility of regulation on the dynamic evolving flexible reality on the ground is challenging.

Timelines of MASS development:

According to the respondent, the view on MASS that had come from the technology providing company Rolls Royce were more on the marketing side –

"Things were not quite as far along as they were saying they were."

Initially these vessels would be operating near coastal and territorial waters. They have accommodation on board for the crew and have a Safe Manning Certificate. The vessel will not operate in an unmanned mode throughout - it would be crewed and undertake certain operations in an autonomous mode or undertake some stages of the journey in the autonomous mode.

Fallacious argument of human error:

The argument that 80% of the accidents are caused due to human error and removing the human would help reduce the number of accidents is fallacious according to the respondent. "*This argument doesn't take into account any error in design, programming, or coding. It doesn't take into account human contribution to safety."* the argument does not take into account the number of disasters prevented because there was someone present to put out the small fire before it could have become big. the framing of the argument to sell autonomous systems wasn't right according to the respondent. *"We are not opposed to automation, but it needs to be used for the benefit of everybody."*

Union involvement in IMO MASS instrument:

The union is involved in the development of the IMO MASS Instrument through the ITF and the International Federation of Shipmasters' Association (IFSMA). A lot of the time, efforts have gone towards keeping the conversation sensible in connection to MASS as the discussion has veered off on wild tangents. In one discussion it had been put forward that one could have an on-board master, a cargo master and a shore-based master, confounding the respondent. The union conducted a survey on members views and submitted an information paper through the ITF. This was the first-time seafarers' opinions on MASS were put forward. With IFSMA, the union has been working on the authority and the role of the ship master in relation to MASS which is an unaddressed issue.

"Throughout the process, the IMO has tended to avoid difficult questions. If something is too difficult to answer, we'll kick it down the road and we'll answer it later."

"The fundamental issue that needs to be resolved is the role of the ship's master which needs to be very clearly set out. There is risk with the definition of the role of the ship master because looking at the way the nonmandatory code has been developed, basically it's a case of, in case of SOLAS everything applies, however, if you have a piece of technology that can do the job of something else that SOLAS mandates then that piece of technology will be acceptable. But in terms of the ship's master what is the piece of technology that allows the role of the ship master to be transferred from the ship to the shore. There is no technology, it's just a matter of principle. You could do it now if you wanted to."

"If they decide anyone can be shipmaster, then we're in trouble." Lack of clarity on the roles and responsibilities of the ship master of future ships contradicts regulations. The master has the ultimate responsibility for the safety of the crew, vessel and cargo, and one cannot make life and death decisions that concern someone else from a comfortable office on the shore when there are people onboard.

The union and national MASS regulations/policy:

In case of the development of national MASS regulations, the union would be consulted. However, in the UK the discussions on MASS are led by the MASS Regulatory Working Group. The discussions are at a low level at the moment and largely involve manufacturers of small craft. The union would get involved later when required and it will be consulted in case of any changes to the UK regulatory regime. The union is invited to the government's discussion table on national regulations. However, the government haven't developed any specific legislation on MASS as yet, therefore the union is not involved. The union is recognised as one of the social partners in the United Kingdom. The government has a legal duty to consult the union and other entities in connection with maritime legislation. These are open consultations, and anyone can comment.

There's a contradiction in The United kingdom's government's role in MASS. The government would like the UK to be a technology centre and be recognised for a favourable environment for companies to innovate and develop technology. On the other hand, it also wants to increase the number of UK seafarers and maintain the UK seafarer base. The retention of UK seafarers is critical to the government. These goals are contradictory. The union would like to ensure that the developed policies help in retaining and increasing the number of UK seafarers.

Importance of IFSMA and other seafarer representative bodies in the IMO:

According to the respondent, the IFSMA is the voice of the ship's master in the IMO. The master has a distinct set of responsibilities. The ship's master has a unique joint role as the owner's representative on board and the person in charge of the ship, its crew and

cargo. The master finds separate representation in the convention as 'Master and crew'. The master supports the implementation and execution of regulations on board. With respect to organisations and their affiliates, there is strength in numbers with respect to representation in the IMO. Entities such as the ITF, the Nautical Institute, IMAREST, and IFSMA Play an important role in getting across the voice of their stakeholders in the IMO.

Union and MASS policy:

The union has a MASS policy.

"We are not opposed to MASS. We believe it's completely a fruitless task to try and argue against the development of technology. You can't uninvent something once it's been invented, but we believe the discussion should be framed around how the technology can be used to improve the lives of seafarers and workers in general and not as a means of reducing their numbers."

"You can't argue against technology."

The working conditions of seafarers are not ideal. They work unacceptably long hours and experience fatigue and health conditions due to work. "*The aim of the technology should be to improve those working conditions*." Employers and governments would need to put in place measures to upskill workers to ensure they are able to compete in the future job market. The union closely followed the developments concerning MASS and its policy evolved from 2017 onwards. According to the respondent, the conversation around MASS, just transition, new technology, and environmental regulations are all intertwined. The union has spent a considerable amount of time and resources over the last five to six years to work in this area. Having a person in charge in the organisational structure who can support the organisation during this dynamically evolving time is extremely helpful.

Union discussion with employers/shipping companies to develop MASS policy:

If there would be any discussions regarding the development of MASS policy, the union would be consulted in their capacity as a major social partner, however, as of now it is not involved in any discussions with employers concerning MASS. The union was involved in very early discussions with one company which contacted them for exemptions regarding vessel accommodation. The company did not strictly meet the requirements; however it argued that the cabin would not be occupied when the vessel would operate in the autonomous mode. The company would like qualified seafarers with sea time to work in their operation centres. The company would like seafarers with STCW unlimited certification to work in their operation centres. Shipping companies require certification / documentation from the relevant trade union if they require exemption on any criteria which acts as a safety net and affords stakeholder engagement. If there is a safety issue, the union would say 'no', and the company can take the vessel elsewhere. However, the union would not like to get a reputation that it is hard to work with otherwise shipping companies/owners would not like to flag with the UK. The union tries to balance the diverse requirements.

Union engagement with other entities on MASS:

The union has tried to be involved with other entities in connection to MASS from the very beginning. The union has engaged with the national regulator, the Maritime and Coastguard Agency (MCA) in the UK. The union has been involved with the ITF, IMAREST, HEIG, and the Nautical Institute. Has also connected with individuals who gave presentations to the industry regarding what the future would look like. the union is involved with the Merchant Navy training board of the UK to upskill seafarers and is also part of the Skill Sea research projects with the European Union. The union is connected to the European Union through their Dutch branch. The union is also involved with

IMAREST which has a special interest group on MASS. The union provides input to the ETF when requested. They are happy to be a part of national/international collaboration for mutual benefit.

Final thoughts/recommendations:

"Technology can be a great thing. Don't look at it as something to reduce the numbers on board. You need to look at it as something that can increase safety and improve the working conditions onboard. Take the seafarers with you."

Appendix 7 – Interview 7 summary

Interviewee details:

Country	Experience
Croatia	Legal background; Union experience, ILO MLC experience

Interview length: 49:24 minutes

Interview findings:

Introduction and experience, background, and context:

The respondent has a legal background. She works with seafarers both inside and outside the country. The union represents around 20,000 seafarers. It is a small union, and they have discussions with the government regarding important issues for seafarers. The respondent has experience of implementing international regulations in the country via national legislation. Due to the various layers in shipping due to its global nature, it is complicated to decide upon the applicable law in different cases and this would get more complicated under MASS.

Croatia is a small country with less than 4 million people. In relation to their population, they have a lot of seafarers as a percentage of the population. They are a seafaring labour supply country, and their seafarers are mostly officers. They have a small number of ratings as the wage does not support living in Croatia. Croatia has Invested into maritime education. It has 4 maritime colleges and 10 maritime secondary schools. The government listens to the union and the union can request for a meeting to discuss pressing issues, such as challenges during the pandemic in which their seafarers could not go on board and those on board could not come home.

View on MASS:

MASS will lead to more questions and problems. There will always be some crew on board as they won't entirely disappear. From a legal perspective it is important to harmonise as much as possible. Standardisation is important as things will be a mess without it. The law applicable to MASS ships will be more complicated. According to the respondent, one cannot expect seafarers to pay for changes with respect to MASS. MASS requires further and big investment that is expected from ship owners as they earn more money than anyone else. The whole system will require substantial funding, decent working and living conditions, and internet connectivity.

“I don't think MASS can solve problems that shipowners have.”

Future seafarers would need to know so much more than just seafaring - they would need to know about alternative fuels, climate action, Environmental Protection, among others.

With respect to MASS, machinery is expected to do all the jobs. In the medical scenario, the doctor is in close proximity to jump in, if, and when required. With respect to an aeroplane, we prefer to have someone sitting there. Automation is some parts is helpful.

“It should be used to help the seafarers to give them some time to rest but not to replace them.”

Automation should be used to make ships more sustainable if possible. Machines should be there to help the seafarers work 8 hours a day and more, if needed. People can adapt to situations better than a machine can.

"We will always need experienced seafarers and to have experienced seafarers they need to have their job."

On connectivity:

According to the respondent, connectivity is a basic human right.

"You cannot take half of my salary just to stay connected. It becomes a basic right to stay connected."

40 years ago, seafarers would stay in port for days; they would get longshore leave and meet other people and be able to walk around. They had more people to do the job and could see the world. Today they cannot do that. With 10-15 people on board, there is less interaction, and they only get to see the port. With MASS this would be even less. There are times when seafarers cannot leave the ship for six months and they work greater than 12 hours a day. They cannot go online and at times this facility is not available. We need to give them something to be able to live like that for a long time. This also impacts situational awareness and has a bearing on safety. If they do not get to experience or know the port, the country, or the climate, it would feel like an enclosed simulator, and they may not know what's going on.

Social wellbeing:

The social wellbeing protections and provisions are extremely important. With a skeletal crew, work intensification, less social interaction and reduced shore leave, crew wellbeing becomes difficult to ensure. It is not only about the remuneration but the guarantees that we can give them when they work in the industry.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument. It is connected to the ITF, but not otherwise involved in the development of the IMO MASS Instrument.

The union and national MASS regulations/policy:

The union is invited to the government's discussion table, but the government is not into MASS as the country is not there yet. They think that this could be for countries with MASS ships not necessarily for labour supplying countries.

Union and MASS policy:

The union does not have a MASS policy. However, in the future it would need to address these issues in more detail.

Union discussion with employers/shipping companies to develop MASS policy:

The union does not discuss MASS with employers, ship owners, and shipping companies. The union needs to discuss current manning levels with ship owners, their safety, mental health, and hours of work and rest among other issues.

Union engagement with other entities on MASS:

The union does not engage with other entities on MASS and is not familiar with the happenings at the EU level.

Final thoughts/recommendations:

The union would like to say to the employers that they understand their need to make a profit, however profit should not be more important than people. Employers need to treat

their seafarers appropriately. The union would like to say that investment should be made in the people working for the company and they in turn will make you even more money.

The union would like to say to the IMO that seafarers are human beings with needs and not machines. The mental health and wellbeing of seafarers is extremely important. They should be supported in their work. Connectivity with family and loved ones is important to seafarers and should be provided.

The respondent would like to say,

“Use MASS to increase earnings for the ship owners but also to make seafarers lives a little bit easier than they are now.”

Appendix 8 – Interview 8 summary

Interviewee details:

Country	Experience
Philippines	Union experience; Seafaring experience; Instructor/teaching

Interview length: 57:24 minutes

Interview findings:

Introduction and background/experience:

The respondent has been a shipboard training officer, an instructor, course developer, curriculum developer, and simulator training facilitator. His seagoing experience started in 2010 after graduation. Between contracts he would work with the education and training department of the company. The sponsor was offering in-house courses beyond the STCW, and the respondent's first role involved course development along the lines of the IMO model courses (6.09, 6.10, and 3.12). He rotated in different departments of the company. The respondent was able to carve a parallel career in Maritime Education and Training with support. The university, shipping companies, and manning agencies would not have a diverse workforce without such opportunities. Such opportunities cannot be given to all from the company side. a lot also depends upon the individual and their willingness to develop opportunities ashore. Career development plus profit would make a sustainable workforce, however it is not easy to achieve it in practise. The union has a private training institution owned and operated by the union and not the government. The union supported the respondent and sent him abroad for studies. The role of the union has evolved from the fighting for basic rights to contribution to sustainability of the workforce in the future. The respondent has a cumulative sailing experience onboard tanker vessel of about 36 months. Prior to his master's studies, the respondent knew little about the IMO. He only knew that it was a United Nations' body concerned with shipping. After his studies his knowledge expanded, and he has a thorough understanding of the nature of work of the IMO; the way it works, and its influence and impact on global shipping. Contrary to elsewhere in the world, there is a surplus supply of seafarers in the Philippines.

View on MASS:

MASS is the product of innovations brought about by the rapid development of technology. It is disruptive or beneficial depending upon the readiness of those adopting it. The pace of technological development is very fast, and the rules and regulations are trying to play catch up with the technological developments. A holistic approach to implementation is needed – the IMO, member states/National Maritime administrations, shipping companies, and maritime education and training institutes need to be involved. The industry and academia need to be involved for the successful development and implementation of MASS.

Timelines of MASS development:

Conventional ships are built to last a long time. Their lifespan is of at least 20 to 30 years and planning for these issues can be put in place in this time frame. Money would need to be invested in education and training, reskilling, ship construction and design etc. The whole maritime sector is much more than MASS and we need to have all encompassing

discussions. Seafarers could lose their jobs but there could be other opportunities ashore for some of them.

Training for MASS:

The production of future seafarers would require educated and experienced seafarers at the centre of the process. With respect to instructors for MASS, administrations have jurisdiction in terms of instructors and assessors. Training would require a combination of technical and non-technical skills; it would need a collaboration of industry experts who make the technology with experts in the maritime context. a robust engagement would be required with the technology manufacturers to unpack future training needs.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument. With respect to training and development, some skills and competences will be retained while others will become obsolete. The IMO needs to identify the gaps and discuss these. The IMO also needs to pay attention to the gap between the developed and developing countries in connection to MASS. Proposals could have a ceiling as it is impossible to reach for the developing countries and they may not participate in the discussions. The developed countries should not be too aggressive with their own agenda, and they should consider developing countries. A balance in the discussions needs to be created for the benefit of all/most rather than a limited few. IMO cooperation depends upon projects and is not perpetual.

"The greatest good for the greatest number."

The union and national MASS regulations/policy:

The union is not invited to the government's discussion table on national MASS policy/regulations.

"It is not even a priority."

The Philippines faces major challenges as a developing nation. Substantial national investment in resources such as human and infrastructure would need to be addressed via a robust legal framework to adapt and welcome MASS in Philippine waters. The seafarer supply for conventional ships and being ready for the emergence of MASS should be a top priority. Seafarer remittances are invaluable to the Philippine economy. The country needs to address this as its dependence on foreign remittances as a major labour supplying country could be problematic in the future. It is the number one seafaring labour supplying country in the world. Philippines should participate and collaborate with other countries to be proactive and not be reactive/passive.

Union and MASS policy:

The union does not have a MASS policy as yet but conducts seminars to raise awareness with the students.

Union discussion with employers/shipping companies to develop MASS policy:

The union does not discuss MASS with employers, ship owners, and shipping companies yet. The respondent would like the shipping companies to collaborate with the government and the Maritime Education and Training institutions. To remain the biggest seafarer supplying nation, employers should give them opportunities in degree 2 and other degrees of MASS ships.

"Shipping companies should not just abandon seafarers. They should help them adapt by developing them and giving them opportunities in order for them to be ready for higher degrees of MASS."

The companies should support the reskilling and training of seafarers. They should take the responsibility for seafarer education and training and the funding should come from them.

Union engagement with other entities in connection with MASS:

The union does not engage with other entities in connection with MASS. The union will continue to explore opportunities to develop and collaborate with other entities. They would continue to work to equip their seafarers and make them ready and competent for manning higher degrees of MASS, specifically degree 2 and remote operations control.

Final thoughts/recommendations:

Investment in young people as maritime human resource would bode well for the future. The union would like the IMO to give clarity on the rapid development of the technological products. As per STCW resolution 15, a review should be conducted every 10 years. However, the last review was conducted in 2010 nearly 13 years ago and the IMO needs to do something about this.

The Philippine seafarers should get involved, be aware of what is happening in the industry, and should be willing to learn and equip themselves with training specific to MASS.

We need to collaborate and work together and not just push individual agendas. This is a global issue and needs to be tackled as one.

At the IMO, the process takes time, and it is catching up with the regulations. It would be good if the regulatory environment moved parallel to the next stages of MASS technological development.

The Philippines government should get actively involved in preparations for MASS. Inclusive thinking and collective efforts are the need of the hour.

Appendix 9 – Interview 9 summary

Interviewee details:

Country	Experience
Philippines	Defence (Navy); Union leadership; Education and training

Interview length: 01:16:03 minutes

Interview findings:

Introduction and background/experience:

The respondent has over 60 years of experience in the maritime industry ranging from defence, education and training to union leadership. His union is an ITF affiliate. He works for the education and training arm of the union. The institution is a tertiary level education institution which is owned, developed and operated by a seafarers' union. He has been with the union and school for 24 years. He talks to the students and the union members about the International Maritime organisation; what the organisation does and its impact in their lives. He also talks to high school graduates and has a weekly TV programme in which he covers life on board the ship and motivates people to try a seafaring life. He is involved in organising and celebrating the day of the seafarer and maritime week in the Philippines where he talks to large gatherings about the IMO. The institute has a steady stream of qualified and competent officers which supports the longevity of the union in terms of its membership. Their focus is on officers. About 5000 officers have graduated from the Academy in the last 25 years at the rate of 200 per year. There is an increasing demand, and they would like to increase the number of graduates to compete with other labour supplying unions. Of 1700 cadets in the Academy, 65 are women. After the four-year course they apply for the Certificate of Competency and can work aboard ships as officers. The preference is to sail for international ships rather than the domestic sector due to the higher remuneration and the contribution of the Philippines to the global maritime workforce. Ratings have a school as well, but local manning agents deal with them. The institute also provides IMO model courses and for up to 20 union members it can offer the training at a subsidised rate or free of charge.

Defence and the merchant marine:

There are several similarities and differences between the defence and the merchant marine. The deck and navigation side are largely similar by choosing the safest and the fastest route from A to B. The collision regulations are also the same. The engines are also largely similar. While the merchant marine carries cargo and has an obligation to the shipper as they are responsible for cargo safety, the defence carries arms and ammunition. The merchant marine may follow schedules and predetermined liner routes etc, the defence does not have a regular liner patrol. The defence undertakes damage control and is designed to defend and is hierarchical and regimented. The merchant marine are civilians and have more work concerning cargo handling operations, paperwork for port visits, and intercultural relations in a multinational crew. The Navy has evolved faster with regards to automation and commercial ships are following slowly. The Navy is supported by the defence budgets while it will be expensive for commercial shipping. The merchant marine can have nine-month contracts with no continuity or tenure of work. In the Merchant Navy one may have people working under them, but they need to do the work themselves. In the Navy a person knows the complete history of everything and can give orders to subordinates. The Navy has about 40 crew on smaller ships and

larger crew on bigger vessels. The Navy gives up to a week to familiarise with the ship and the work. In the merchant navy there is limited number of crew, limited familiarisation, and due to the limited time on board ships, safety issues may arise.

Developments and training:

According to the respondent learning continues along with developments in the industry. One needs to talk about alternative fuel additives to reduce carbon emissions and control carbon limits. Currently, the industry is still largely using fossil-based fuels. People will need to be trained to cope with new engines and new training requirements. Membership should be made aware of what's happening and what's going to come up on the horizon so they can be better prepared. The union has the obligation to protect its members; It has the opportunity to influence, but not the power. Therefore, it informs its membership to keep abreast of the changes by staying updated. In order for everyone to continue to have jobs, one needs to be aware and prepare for the changes. Japan is providing Philippines, type specific training for ECDIS. The union keeps engaging with Japan to learn more. The union sends its instructors on scholarships to the World Maritime University in Sweden, Chalmers University in Sweden, the South-Eastern University of Norway, Tokyo, National Taiwan university etc. They send students to pursue Master's degrees and short courses and take part in joint research projects with other schools to stay in the know. The union organises seminars on decarbonisation, cyber security, digitalisation, logistics chain etc. They condense the learnings for the seafarer. In addition, predeparture seminars and orientation seminars are conducted wherein the seafarers' rights and benefits are informed to them. The union highlights what the future holds for the seafarers and what its training institute can offer them. The union has trained about 970 simulator instructors all over the country for free.

Union engagement in IMO:

The respondent has worked to connect the union with the ITF, particularly in connection with IMO. Over the last 1 & 1/2 years the focus has been on just transitions. Discussions have not only focused on MASS, but on alternative fuels, alternative engines etc.

View on MASS:

"We should use the advances in technology to make our lives easier, not to make it difficult."

"MASS is just an instrument for us to improve our lives. So, it's not there to kick you out of your job."

"It is a steppingstone to make things easier for us."

MASS should be utilised to make operations efficient. According to the respondent, it can be seen as an opportunity as there are other ways of getting jobs in the huge logistics chain. Shipping is a small part of the supply chain. Jobs can move ashore in remote control centres and with working with technology in other areas.

"Repair is not automated. Somebody has to do the repair."

Timelines of MASS development:

"We are not going to have unmanned ships. The elephant in the room is unmanned ships. They're not doing it overnight. Ships are built to last 20-30 years, by that time you would be retired."

MASS is still a long way off and the respondent does not want the membership to worry. Citing the example of autopilot That has been around for over 2 decades, he states that one should not be worried about automation as autopilot is nothing, but automation, and

it helps the seafarer. Onboard automation will be increased little by little so seafarers would need to do less work. The respondent states that the membership would need to be prepared as more and more things will be automated over the course of time. There is an element of anxiety in the membership there is a message for the IMO to send messages to calm the industry.

Union and MASS training:

The union is trying to acquire MASS simulators in 2023. The simulator will have remote operating stations/shore control stations to simulate moving unmanned ships from A to B from the shore. The union is in talks with a simulator manufacturing company with respect to the digital twin of a vessel. The union sends staff to the university of South-Eastern Norway for training so that upon their return they can train the cadets, officers, and union members in the Philippines.

On shore control centre staff:

"They have to be seafarers. In the event that any advanced automation or meaningful reduction of personnel aboard ship will happen, you are going to use the people that you have taken off the ship and you have to use them on the shore."

As part of the collective bargaining agreement, the union can train the seafarers and they can continue to work for the company. The union would try and take the lead on training, correct any issues/errors and showcase it in the event others would like to see sit. The respondent notes that the government would like to standardise training whereas the union school has additional standards. STCW is a guide and its philosophy is based on minimum standards for all. This is lagging and out of date. It needs to be tweaked so it is responsive for now and the future. Many schools and countries would not be able to achieve it straight away. However additional requirements would need to be stipulated for MASS, decarbonisation, digitalisation etc. The school gives extra over and above the STCW requirements. One needs the willingness and support of the government in this. Without investment from the government or companies, it would be difficult to take this further.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument.

The union and national MASS regulations/policy:

The union is invited to the government's discussion table on national MASS policy/regulations. The union is part of the maritime industry coordinating committee along with the administration. The discussions do not focus much on MASS as there are other concerns to be prioritized.

Union and MASS policy:

The union does not have a MASS policy as yet. The union is still developing it. The union believes that its policy would come from the education side. Shipping companies are going for decarbonisation, and LNG fuel vessels can last for the next 30 plus years. The union is trying to increase its awareness so that it can be prepared to provide training as necessary.

Union discussion with employers/shipping companies to develop MASS policy:

The union does not discuss MASS policy as such with employers, ship owners, and shipping companies.

Union agency:

"The union can do much more than they actually think."

The union strives continuously to engage with other entities and be aware. International cooperation is extremely important and part of finding out what the union needs to be aware of, it works with entities such as the Philippine government, the IMO, the ITF etc. The trade union leaders are working around the clock to be ready. the union has made a commercial agreement with simulator training technology provider to stay ahead.

Message to Filipino seafarers:

"Continue doing your best in whatever you do. if you need additional training, the union is here... don't worry you are a member of an organisation that cares for you."

Final thoughts/recommendations:

The respondent would like to request that the IMO should lead in requesting flag states and ship owners to contribute towards greater awareness of what the future will hold. Without sacrificing trade secrets, the union and higher education institutions need to know what to prepare for to meet the demands of a volatile and uncertain future. With respect to, *"no one left behind"*, the respondent wonders how to operationalize the concept. If one understands the timeframe of the next two decades or so, then it can be planned for. The IMO should play a role in reducing the uncertainty and having a calming influence on the industry.

The respondent would like to encourage transparency in information sharing -

"To make things easier, why not be transparent and talk about it."

Appendix 10 – Interview 10 summary

Interviewee details:

Country	Experience
USA	Union leadership experience; At sea experience as fishery observer; Experience at IMO & ITF

Interview length: 01:07:31 minutes

Interview findings:

Introduction and background/experience:

The respondent has been seconded to the ITF and has IMO experience which includes MASS. She has been part of a programme wherein the industry, government, and academia work together collaboratively for the betterment of the industry. Her seagoing career has been that of a fishery observer on board ships in the Bering Sea, the Pacific, and Alaska. Her work included collecting scientific data that is used by the government to manage fisheries. She wasn't a union member when she worked on board. Her union represents seafarers, fishery observers and fish process workers. She has been representing workers since 2004. between 2016 to 2020/21 she has worked at a training facility but not as an instructor. She hasn't had much direct seafarer interactions since COVID. As a guest speaker she talks about the IMO and its work. Her union represents ratings as opposed to officers. They have crossover programmes with the officer union's training facility with respect to bridge resource work. The training facilities are influenced by the STCW, IMO, and are U.S. Coast guard approved. These are for mariners who sail internationally. There are different requirements for mariners who sail in national waters and river systems. The union is linked to the IMO; it interacts with the US Coast Guard to understand and influence what is happening; it is also connected with its ratings and has an understanding of what the membership is broadly concerned about. Currently the membership has concerns about loss of jobs, the burden of training, and worry about becoming redundant and/or getting replaced.

View on MASS:

According to the respondent, *"MASS is entirely the wrong name"*. It is the wrong term to use. The work she is doing at IMO is not just looking at MASS ships but at highly automated ships. Multiple ship types exist and there is not enough of a distinction between highly automated ships and initial MASS stages today and there are completely different requirements for the leap from the highest level of automation to autonomy. The term MASS encompasses more than what the name suggests. It spans the whole continuum and all levels of automation and autonomy that are not captured by the term. A large body of work needs to be done with respect to MASS. More work needs to be done on automation and workflows; on the technology to prove that it works and ensure that it works. if human interface is required, it needs to be determined whether humans will be remotely monitoring from the shore or working on board. If a position is not required anymore as it has been automated, then retraining should be offered to work within the technology. The IMO has defined four different levels of MASS for the regulatory scoping exercise. These four levels may not be suitable anymore. We need to have more clear definitions and descriptions about what we're talking about. Systems can take away some of the monitoring by seafarers and they can understand the signals and intervene, if necessary. Technology and automation are to benefit the seafarers. Having no paper charts, compass, or the sextant contributes to support navigation. Previously MASS was

sold as the solution to overcome the shortcomings of humans who were presented as the problem. This was the wrong way to go and subsequently the sales pitch was shifted in this regard. Instead of saying that errors come from the human element and that the human is the problem, human contribution to safe operations should be acknowledged. Instead of MASS, we should be talking about highly automated systems - Engineering systems, firefighting systems, navigation systems etc. The systems are automated, but people are on board with duties. Experiences from other areas are being applied and discussions are being carried out to come to the best outcome possible.

"This is new for everybody. We are all winging it. Nobody has experience in this yet."

Timelines of MASS development:

With the use of the MASS term wrong ideas are projected to the seafarers and the industry. They focus on autonomy and automation, and artificial intelligence invokes people to think about the distant future and makes them jump to the wrong conclusion.

"The way that MASS has been presented has put a lot of people off because they jumped to the end stage instead of what truly is next."

"We're not going to see vessels that run completely autonomously with no people on board with nobody operating it from the shore side. This completely autonomous vessel making its own decisions out in the water without any human involved, that's way down the road."

"What is more realistic is the short term and by the short term I mean 15-20 years quite frankly, is highly automated systems and that's what we should be talking about."

Union involvement in IMO MASS instrument:

The union is involved in the development of the IMO MASS Instrument. The respondent would like to know what is coming down the road so they can prepare for that. She would like to influence the conversation and decision making at the IMO with respect to MASS. The respondent is highly involved in IMO meetings. She is part of the correspondence group. She has also been involved in the committee and subcommittee since its inception. She is a part of most IMO meetings that discuss MASS and has been highly involved for the last two years. She chairs the subgroup of the correspondence group that is developing the code - the gold-based standard of personal safety and comfort. 13 different subgroups are working on diverse topics and systems, and she is currently leading that. The union would like information pertaining to anything to do with seafarers with respect to their training, safety, navigation, fire safety, remote operation centres, work environment, and training and skills and development. The IMO is looking to approve the non-mandatory code for cargo vessels only by 2025 and the first draft of the code will be presented at MSC 107. The subgroup on personal safety and comfort is looking at ergonomics in connection to remote control centres. There are several advantages of a trade union in a subgroup. The IMO wants their input and recognises their ability an expertise to provide input. Through the ITF, it gives them an opportunity of being heard. and once they are part of the conversation, they are called upon a little bit more instead of being a mere observer. Building relationships with stakeholders is extremely important. There are a few negatives as well: delegations need to prioritise where to commit resources as there is so much to look at, and personal safety and comfort may not be high on the list. Participants may monitor, but not contribute to the discussion. The union will see how it goes after the first draft and if there is agreement or not. What the MASS code is meant to do is to supplement gaps in the existing conventions and requirements where highly automated or autonomous ships are not covered. According to the respondent –

"If you have one person on board the vessel then every single requirement that exists for people on board vessels has to apply."

However, not everybody agrees with this view and some say it should be based on the number of people on board. If there is nobody on board then there would be no requirement for berths or for addressing noise and vibration concerns. The union has experience with workplaces that downsized, and people lost their jobs. The union can bring this perspective to the table. A percentage of the downsized workforce needs to be retrained to remain in the industry and the others need to be retrained for working elsewhere.

The union and national MASS regulations/policy:

The union is not invited to the government's discussion table on national MASS policy/regulations. In the United States there is an advisory committee and 18 members sit on it drawn from a cross section of industry That could include unlicensed ratings' representative, a representative of a maritime training facility, representative of an international company, academia etc. Questions can be posed to the committee from the assigned questions to help inform the government and it is not a free for all. The government does not say that they are developing regulations for XY and Z and they would want to know the impact on the segment represented by the union. The committee gives the recommendations back to the government. The union proactively works within those committees. There are several unions in the United States and the union representative of the respondent may or may not sit on that committee. Therefore, they cannot be the decision makers. The respondent feels that sometimes the government is not always open and transparent. The government is not laying out the information for the unions. The respondent's union actively seeks the information regarding what is going on. As part of the cooperative programme the union participates in numerous workshops and symposiums where the government is invited to share the developments. The union is proactive in identifying forums where pertinent topics are being discussed and participates in them. The government does not have an obligation to consult the union.

"They are not reaching out to us. It is up to us to reach out to them to have that discussion. We have to seek opportunities and make opportunities to provide our viewpoint. If we don't, it happens without us."

The respondent can take the knowledge of the IMO back to the government. Unions have relationships within government entities such as the USCG (National Maritime Administration), and the Congress.

"A regular seafarer member is not going to have the ability to have those conversations as the decision-making process is happening at the government level."

The union would like seafarers' interests to be protected in terms of their safety and training.

"We want to be sure that the end result protects seafarers as much as possible."

The union is currently mainly reactionary. It reacts to the technology being developed and to what is happening around them. The union is not driving; it is not doing the proposing; it is not driving the changes. The union will propose to the government where they see opportunities. It would like to take on a more proactive role.

Union and MASS policy:

The union does not have a MASS policy yet.

Union discussion with employers/shipping companies to develop MASS policy:

The union does not discuss MASS with employers, ship owners, and shipping companies.

"The union does not know enough. the company does not know enough. The union is looking to the ITF for things to discuss with the company. What should they

negotiate about - the union needs that information from the ITF and the SOCP to inform them about what they should be looking into."

It is the trade union's responsibility; however, the trade union does not know what they want as they don't know what the options are.

Union engagement with other entities on MASS

The union engages with other entities such as the SOCP, USCG, ITF, and the IMO in connection with MASS.

Final thoughts/recommendations:

"Don't leave the people behind, those that need to take on the new positions, or the new work, or the new way the work will be done, and those that are completely blocked out of the jobs."

"I don't personally think that we're going to see a large loss of seafaring jobs at least not for a while."

With respect to seafaring jobs what could happen is that more and more jobs would move ashore to the remote-control centre in which case they will no longer be defined as a seafarer and may not need seafaring experience. If a young person with a background in playing games and gamification would get the job, one doesn't know. However, a 30- to 40-year-old may not be easily able to transition to those jobs.

"What I would like for the IMO and administration and decision makers at large to understand is, and this speaks to the history that we as unions bring to the table, our experience during the last industrial revolution and industry 4.0 will have a similar impact of shifting the industry. It took three generations to recover from the economic impact, upset, and loss from the industrial revolution and that's not acceptable. As we move forward with this, we need to take the social aspects into account."

Some of the money that the company gets to save needs to be put in a programme that helps displaced workers to recover so that it doesn't take three generations to recover.

"There needs to be more information sharing because we don't know what the options are. We don't know what the impacts are because we don't know the technology that's developing. We don't know what we don't know."

Appendix 11 – Interview 11 summary

Interviewee details:

Country	Experience
India	Union leadership experience; Sailing experience – 45 years; Command experience

Interview length: 55:22 minutes

Interview findings:

Introduction and background/experience:

The respondent's union has 45,000 registered users of which 20,000 are active. He has extensive seafaring experience at sea of 45 years of which 27 years as a sailing master. He has worked for several ship management companies.

View on MASS:

According to the respondent, *"MASS is there to stay"*, and as with every new technology there are always challenges and setbacks and we need to adapt. MASS would be both evolutionary and revolutionary. The international regulatory body, the IMO does its due diligence and when it takes a call, the project does not get cancelled, and over time the people and the industry adapt to it. According to the respondent, the fully unmanned stage 4 is at least a decade away. Manning begins to reduce further in stage 2 MASS ships; stage 3 ships are like a final call which evaluates the efficacy of everything before proceeding to stage 4 ships. With respect to the shore-based control stations, the respondent believes that experienced people will be placed ashore and there will be challenges with respect to the safety and rules of the road in congested waters such as the Far East. According to the respondent, the maximum fishing traffic is in the Far East in countries such as Singapore, Malaysia, Indonesia, Vietnam, China, Japan, Korea, Cambodia etc. In the Malacca straits and near the coast in the Indian Ocean, manoeuvring becomes a challenge and requires a lot of time and effort to ensure that no incidents and accidents happen. These days even fishing Nets are equipped with the AIS and the person will need to identify from a long distance if it is a net or a small boat. With fishing vessels in reduced visibility or thick fog, questions may arise. We may need updated sensors and sound signals etc. to gain situation awareness. According to the respondent there is a big task ashore. The respondent keeps himself apprised of all the latest developments in the industry by reading extensively. Aircraft control towers do not face challenges faced by shipping. In shipping the arrival, departure and movement in restricted and congested waters poses challenges. Fishing nets can drift, and one cannot foul the propeller. The respondent believes that we are still not talking about cargo operations with respect to MASS. The presence of cameras, though assuring, would not resolve everything, and sensors may give way. In any event we cannot have an oil spill.

View of control station:

The manning scale would need to be addressed for the shore-based control stations. MASS Would require people to be inducted onshore and lots of data would need to be analysed. training would need to be important to work in a shore-based control station. The IMO instruments are not rigid; They have inherent flexibility to suit national requirements. Operators would need to have patience and should not panic. One controller might get 4-5 ships to handle otherwise they might err. There could be a series of alarms and warnings going off that need to be addressed. One would need to be mindful

of the time lag between the sensors capturing and sending information and the consequent line of action. operators would need to be trained in crisis management and soft skills. In a challenging situation aboard a manned ship, additional hands can be placed on the bridge for monitoring the RADAR and the ECDIS, and the engine room can be put on standby as one cannot afford to have an incident/accident. The respondent believes that the knowledge and experience that seafarers have is crucial and would need to be translated to the shore-based control centres.

Manpower situation:

The Directorate General of Shipping in India issues the licences, and the trained deck and engine cadets are largely assured of placements on board and can also access the support of the union. Some private colleges in India do not fulfil the placement requirements of the students and hence some may not get access to seagoing experience. Due to the Russia conflict, and other factors there is a shortage for all ranks, and most find a job. The reputed companies have in-house trained cadets, and the trainees know the culture of the company. Training in manpower is an investment. However, there is no guarantee of job security in the future. The Indian union is interested in ships, coastal vessels, tugboats etc but not the fishing industry as fishing vessels have lots of local unions to cater to their needs.

Timelines of MASS development:

MASS will take time to become a reality. It is impossible in the next 10 years. A cadet's job can take over a year to gain essential experience. There are not many jobs that require so much training to work on board. The IMO code is not rigid. STCW will be completely revamped. Load lines for MASS would change and that could take a decade before it happens. With respect to SOLAS, the freeboard might be reduced. Flag states might try to increase tonnage, and ships might be made lighter to carry cargo. The IMO has experts deliberating across different committees and the MASS code can also be amended in the future.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument. The respondent would like to convey to the IMO to undertake a comprehensive training gap analysis. The STCW code and convention would need to be revised. The methodology in the STCW is not suitable for autonomous ships, therefore a completely new syllabus, curriculum, training modules, training duration would need to be delineated for each rank and accordingly the union could encourage its membership to upskill and reskill.

The union and national MASS regulations/policy:

The union is not invited to the government’s discussion table on national MASS policy/regulations. The union does not have a status or direct connection to the IMO. It is important to have a channel to connect to the IMO. One channel is to go through the national government and that is not easy. The union can indirectly participate through the ITF as the latter can send papers to the IMO MSC. The union would like to address crewing and manning requirements with the government. The union would like to discuss the supply of skilled labour with the government and would like clarity on the proper syllabus/curriculum for the training. The initial training should be supervised by Director General of Shipping staff. There should be some competency exams and practical exams incorporating simulators as well. The question raised is that who would pay or fund the training? Would it be the government or the union? The respondent believes that additional certification was required in the case of an Electrical Officer upgrading to an

Electro Technical Officer. It would be the same in the case of autonomous ships. There would be lots of engineers required ashore for maintenance. With respect to the minimum manpower required on board, the respondent states that previously there were more than 40 people on board which has now reduced to an average of 20 or less onboard oceangoing ships. This has repercussions for the mental wellbeing of the crew as they can feel lonely and get depressed. This also has repercussions for STCW and SOLAS as we need staff on board for carrying out training drills. The union would like discussions on these issues with DG Shipping and would like the DG Shipping to take them to the IMO.

Union and MASS policy:

The union does not have a MASS policy yet.

Union discussion with employers/shipping companies to develop MASS policy:

The union discusses MASS with employers, ship owners, and shipping companies. The union would like to know about training with respect to MASS. They would like literature and relevant study material to be shared with them. The respondent believes that it is his responsibility to ensure that the union's officers get the best of teaching and training. If the union comes to know of a particular company that has a useful course, it advises its membership to enrol and would consider funding. FOSMA company has started some sort of MASS related training. They have started data collection and data is regularly coming from the ships. The company is trying to gauge which operations are needed to be done in person and which operations do not require humans on board and can be moved ashore.

Union engagement with other entities on MASS

The union is engaged with other entities in connection with MASS. The respondent is keeping in touch with all parties as it is important to know information and have a network of connections. The respondent believes that one should not have a mindset that one is suitable for only one role. One should not consider oneself redundant. Seafarers should not need to see their career path as rigid.

"Nobody shuts the door for you. You shut the door for yourself."

Final thoughts/recommendations:

"I would like to say that keep sharing the information with all the institutes even the trade unions." The dissemination of the meeting minutes, discussions, and soft copies of documents including feedback is very crucial as people need to read through, reflect, and contribute. According to the respondent, we should not land in dangerous territory with respect to stability.

"If you are thinking of compromising on the load line of MASS, you have to see the integrity of the stability."

The design and construction of mass vessels, including their stability would be one of the biggest challenges.

Appendix 12 – Interview 12 summary

Interviewee details:

Country	Experience
Russia	Union leadership experience; Seafaring experience; Teaching experience

Interview length: 01:11:38 minutes

Interview findings:

Introduction:

The ministry of transport of the Russian Federation oversees the various modes of transport, including maritime. The respondent is from a seafarers' union in Russia. He has teaching experience at a University in Russia where he is responsible for the professional training and development of maritime and offshore personnel.

Technological development – GMDSS and the respondent's experience

The respondent graduated in 1983 as a former radio officer, a post which is no longer in existence. Modern technology in the form of GMDSS directly impacted the respondent's career. He was trained as a future maritime radio operator and the sending and receiving of messages utilising the Morse code would take time. Meanwhile developments were taking place in satellite and digital communications and INMARSAT. As a student, the respondent was never told about the technological developments underway that could change his professional career completely. After graduation when GMDSS started to be implemented in the mid-1990s and ship owners faced options on how to integrate the technology. Where labour was cheap, radio officers would be preferred on board and where labour was expensive, they preferred duplication of equipment on board with shore-based maintenance. Many radio operators lost their jobs. some started retraining to be deck officers and changed their profession from radio operation to navigation. They returned to university to learn subjects such as computer sciences, radio electronics equipment etc. GMDSS training for deck and radio officers was organised for countries of the former Soviet Union such as Lithuania, Latvia, Estonia, Ukraine etc. Courses on ARPA and integrated bridge and refresher courses were created and up to 20,000 on an annual basis are trained in the university.

The reaction to the technological development impacting future career, differs from person to person. Some were shocked completely while others who wanted an opportunity to remain in the industry, changed the direction of their professional career with additional training and practise. About half of the colleagues lost the maritime jobs and worked ashore as radio electronics personnel, in computer science work and R&D related work. Those that wanted to work at sea had to change from radio operators to the deck side. *"You have to be ready. You have to be afloat."* Back then the seafarer's union wasn't so strong, and the challenge fell on the shoulders of the seafarers themselves and shipping companies. If it was a good company, it would try and take care and keep personnel as long as possible. The respondent wasn't sure whether the government or the ministry or the relevant authority would care as much about the career transition. Digitalisation can change job opportunities and can lead to the same loss of jobs as previous industrial revolutions.

View on MASS:

"A complete disaster."

Digitalisation can be compared to GMDSS or a new technological revolution that can highly influence the labour market. It is comparable to the industrial revolution in England or Holland that changed the labour markets completely. 100 years ago, there were steamships and the number of people that provided energy to the ship were not seafarers but worked with coal. These days we have 3-4 ship engineers on board.

"The industrial revolution will change the labour market and the attitude to the maritime profession. the continuous development of these technologies' day by day, week by week, year by year will influence the labour market."

The world has positive and negative outcomes which depend upon how much we shall prepare for the global challenges and our attitude towards these changes. If the crew is cut by half, what is to be done with the remaining people? and how many cadets would need to be trained in the maritime colleges?

MASS Needs much more research in the area of training needs, regulations, equipment, procedures, safety, cargo operations, manoeuvring, navigation etc. There should be exchange of research and collaboration is key. Countries such as China, Norway, Denmark, South Korea would better understand what to do and how to do with respect to MASS.

Education, Regulation, Shipbuilding, and Timelines of MASS development:

The education system is a conservative system and training programmes take time to evolve and change. Regulations also take time to evolve and change. The comprehensive review of STCW will take time and the new convention could be implemented between 2030 to 35. In an environment where regulations and training are slow to change, technology is very quick. The harmonisation of regulations is challenging and to change attitudes also takes time. According to the respondent 99% vessels are conventional ships with a lifetime of between 20-40 years. Seafarers will continue to serve onboard conventional ships that exist in the same regulatory world.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument. They are looking from the sidelines regarding what is going on in technology, shipbuilding, R&D, education etc. They are trying to get information on the developments underway. The union would like to tell the IMO that MASS can influence ship construction approaches, equipment, seafarers' roles and responsibilities, navigation, search and rescue, cargo operations, port approaches, communications, loading, discharging, keeping cargo on board the vessel, on board maintenance if required, rules of the road, port operations/procedures. Seafarers' unions need to work in this area with the stakeholders to get a clear understanding of the roles, responsibilities, and function of seafarers, a clear function of cargo operations etc.

The union and national MASS regulations/policy:

The union is invited to the national discussion table in connection with the development of MASS regulation/policy. The union would like to tell the government that when they develop MASS national regulations, they should develop a table of competences for those who operate MASS ships and for all classes of MASS ships. A clear understanding of the competences required is needed. Previously one needed to be a ship master/chief mate to work in the VTS as they had the experience behind that. When it was difficult to find higher ranked individuals to serve on the shore, additional training was given to

compensate for the lack of experience to operational level employees. For example, Germany hired graduates with no seafaring experience and give them additional courses and on the job training to compensate for lack of experience. With respect to people in the remote-control centre, we need a table of competencies that delineate the required competences, how to approach them, how to assess them, and what background or experience would we need with respect to the teachers and instructors. The clear delineations of competences and the quality of the instructors is the responsibility of the government according to the respondent.

Union discussion with employers/shipping companies to develop MASS policy:

The union does not discuss with employers, shipowners or shipping companies in connection with the development of MASS policy. The union would like to say to the employers that, *"What is most important to the ship owner is not to be in a hurry with implementation of all this. you need to measure 7 times and then cut."*

Union's engagement on MASS

The union has decided to work with two universities that are involved in MASS research with respect to training and other related aspects of MASS. Several shipping companies take part in the national experiments on MASS. One company is responsible for the VTS and pilot operations. There is a plan to build autonomous port tugs. Another company undertakes icebreaking operations. Shipping companies in Russia are trying to see what economic outcomes they will see in connection with investment into MASS. Currently research and information gathering is going on. The national programme for the implementation of MASS was presented at the HTW committee in the form of an information paper from Russia.

The Vice Prime Minister of Russia is responsible for autonomous transport (aviation, merchant marine, road etc.) In connection with the state plan, a group has been organised which combines research and development, companies, regulatory bodies, and training institutes which undertakes weekly discussions that are led by the Ministry of Transport to crystallise the road map for the implementation of MASS in Russia. Trade unions take part in this via maritime universities.

As part of the roadmap Developed by the ministry of transport, 2 ferries (sisterships) have been equipped with elements of autonomous systems. These ferries ply between Ustluge Fort in the Gulf of Finland to Kaliningrad near Poland in the Baltic Sea. These ferries started operations in 2022. a simulator course is being developed for these ships. In the beginning the installation of elements of autonomous shipping will be done to vessels in the first and second category of MASS ships where some operations managed by the crew will be reduced and some operations will be moved ashore to a remote-control centre. The government will see how this will work prior to undertaking additional implementation. Seafarers should be prepared for upskilling and reskilling. Work is being done in that direction; however, we are not there yet.

Importance of information sharing/communication:

There should be information sharing on different levels such as the trade union, the government and the IMO. There should be synergies between trade unions, seafarers, research and development entities, training institutes, regulators, technology developers, and companies.

INMARSAT, radio communications, satellite communications are at the heart of MASS. Without stable, safe, and reliable communications within the ship, port, cargo owners, VTS, rescue centre, remote control centre etc. achieving MASS operations would be a distant reality. Without robust communications this development would remain unrealised.

Final thoughts/recommendations:

"Those people who took the right wind were on their way. You see the technology is coming, you need to find the right wind and you will be on the wave and then you surf. Same here, seafarers need to keep abreast."

The continuous development of skills and knowledge is extremely important as one could lose one's job someday. Whenever the reskilling or upskilling is required by the labour market, the trade union is the right organisation to inform about this to the seafarers. The technology revolution will change the nature of their work. They need to follow what's happening in the industry to be prepared for it. With the cooperation of stakeholders such as the government, the IMO, labour supplying countries, seafarers, and ship owners among others, MASS could be realised over time.

Appendix 13 – Interview 13 summary

Interviewee details:

Country	Experience
South Korea	Union leadership experience; Rail experience

Interview length: 01:04:54 minutes

Interview findings:

Introduction and background/experience:

The respondent has been with the union in South Korea since 2008. The respondent has experience in rail transport. Even though he does not have a seafaring background, his experience has exposed him to the threat of job losses, injuries, and fatalities experienced by transport workers in other industries such as rail. The ITF represents transport workers such as seafarers, dockers, railway workers etc., and the respondent's national and international experience in the railway sector makes him well suited to support workers in different transport industries.

Previously, as an interpreter in the company, the respondent supported individuals from Belgium, the United Kingdom, France etc. He got an opportunity to work for workers who had been injured or killed when hit by train. He notes that while passengers could enjoy the travel, it is difficult for workers as night-time driving is risky, complicated by fatigue which increases the risk of accidents and devastating consequences. The respondent has valuable experience in casualty management, understanding of fatigue, and accidents. The respondent can apply lessons learned from different transport sectors to maritime.

Fishers in South Korea

The respondent's Union also represents fishers in South Korea. The younger generation does not want to join the industry as it is laborious work, and they are exposed to risk and inclement weather. They can get injured or killed in accidents. They can be exposed to the cold sea, and death can be due to hypothermia or drowning. Currently there are over 2000 fishermen with the majority coming from countries such as Vietnam, Indonesia, and Sri Lanka. This leads to communication problems as well as culture shock. The disputes between the national and foreign fishers can pose serious problems. South Korea needs fishing manpower to maintain the fishing industry, and foreign workers looking for work want to come to South Korea, but this is not free from challenges. Greater than 80% of fishers are self-employed with about 15% employed by companies. Maintaining fisheries in the future is challenging in the country. They need cooperation between the union affiliate, the industry, and the ITF. The fishing industry in South Korea needs to invest in language and culture programs. A mere three days of language and culture training is insufficient in this regard. The union has also joined the STCW-F committee at the IMO. The union considers the concept of one sea and doesn't regard fishing and commercial shipping separately.

Union engagement in IMO:

The respondent has worked to connect the union with the ITF, particularly in connection with IMO work. The union would like to remain abreast of the rapidly changing technology trends, and the happenings in the IMO meetings and other international developments. For the union, safety is extremely important to protect their members. They need decent

wages, safe working environment, and no fatigue for their members. The respondent would like the union to have a national and international voice.

View on MASS:

According to the respondent, MASS is challenging, but is an opportunity for the industry.

"The implementation of MASS has the potential to significantly transform the maritime industry in several ways – increased efficiency, reduced cost, enhanced safety, and improved environmental sustainability."

It is a new business area and opportunity for the government. MASS has security and privacy concerns that need to be addressed with respect to data/information sharing. There are legal, technical, operational reliability, and regulation related issues. Additionally, the industry needs to consider the safety and wellbeing of individuals in the industry.

Timelines of MASS development:

MASS will take time to become a reality. It is impossible in the next 10 years.

Union and MASS training:

With respect to seafaring officer/operator training in which the individual would flexibly move between the ship and the shore-based control station, the union would like the individuals to be competent as per STCW. The union is currently unsure if a separate MASS Certificate would be required for new recruits in the control centre.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument.

The union and national MASS regulations/policy:

The union is not invited to the government's discussion table on national MASS policy/regulations. The government has highlighted the business opportunity instead of individual safety and sustainability of the industry. The government is currently more concerned about the technical and regulatory issues, but they also need to consider the living and working conditions of the seafarers/operators in the industry. It is difficult to get the union's voice heard, however, the union would like the government to collaborate with it on pertinent issues.

MASS should ensure the safety of all involved and ensure the reliability and safety of autonomous systems. The respondent believes that the government is currently not ready to receive their voice. The union would like their position on MASS and attitude towards it should be respected. The country representative was surprised to see the South Korean Union representative participating through the ITF. The respondent recognises the importance of representing the union at national and international forums irrespective of resistance. The trade union would like to cooperate. It would like to complement what the others are doing in the MASS space and point out any gaps. It would like to engage in tripartite discussions with the government and the shipping companies. They believe that it is important to listen to different voices, attitudes, positions, and perspectives to follow what is going on regarding MASS. The union believes that it is important to be connected to the IMO, the national government, and the companies to keep in the loop and discuss developments together as the stakeholders need each other.

The union would like a human-centered agenda for the safety and well-being of the seafarers and the fishers. They would like joint meetings at the national level so that their voice and opinions are not neglected. They would like the government to be positive about

the trade union. The respondent believes that gradually the trade union would be invited by the government.

Union and MASS policy:

The union does not have a MASS policy yet. Until now it does not have a specific body or forum concerning MASS.

Union discussion with employers/shipping companies to develop MASS policy:

The union discusses MASS with employers, ship owners, and shipping companies. The union visited the shore-based monitoring centre of HMM – Hyundai Merchant Marine where they are preparing for autonomous ships, however the work is not complete thus far. With respect to the shore-based Master/Operator, the government and the company want to amend the regulations. They would like a direction in favour of onboard and on shore flexibility. They would like flexibility in the regulatory environment. Currently it would be a pilot project to collect data. They would like flexible officers. The union at this juncture doesn't support this view. With respect to the flexible movement of officers onboard and ashore the union would like the personnel to be competent as per the STCW.

Final thoughts/recommendations:

Any concerns of MASS technology must be addressed to improve and promote a positive perception of the technology. Supply chains are connected, and the government, company, and the trade unions need to work together. Transparency and due diligence are required for success. Currently, the government seems to appear the least transparent. With less crew onboard ships and the increase in fatigue, we need to invest in safety and the maritime human element. It is good to see collaboration between the ILO and the IMO.

"Please don't see human as a cost."

"Please listen to our voice. Please be honest with us. We want to know what you're thinking about MASS. Don't hide the facts from the union. Be more transparent."

"I want to say to the government, and IMO, and the company side that it's important to consider the potential impact of MASS on the environment and to take steps to minimise the impact. Please listen to the voice of the trade union. This includes reducing the emissions from the ship and protecting the marine life and preserving the sensitive coastal and oceanic ecosystem."

"MASS should be adapted in a way that benefits everyone and that the technology is used in a safe, responsible and sustainable manner."

Appendix 14 – Interview 14 summary

Interviewee details:

Country	Experience
United Kingdom	Seafaring – 9 yrs; University post graduate degree; Union experience; Spokesperson experience in ILO

Interview length: 52:42 minutes

Interview findings:

Introduction and experience:

Navigation officer who came ashore to pursue higher university studies. Had sailed onboard Bulk Carrier and made redundant in the 1980s when it was a difficult time for shipping. Was a 2/O when he came ashore. The respondent would study at university and go back to sea during the holidays. The respondent's union in the UK merged with the Dutch and Swiss counterparts and formed a union that serves maritime professionals in shipping and inland waterways at sea and ashore in three countries. The respondent is second generation in the shipping industry and believes, "Once a seafarer, always a seafarer." Since pursuing a shore-based career in the industry, the respondent believes that his *ship is ashore*. The respondent is the spokesperson for the seafarers in the ILO in the special tripartite discussions.

School Education in the United Kingdom:

Grammar schools cater for the academically inclined and after secondary school students can pursue technical apprenticeships and enter the work force.

The Deck and the Engine and if the twain shall meet:

There is a love-hate relationship between the navigation and the engineering department. The respondent states that the deck department has a strategic vision whereas the engine department has a *'How do we fix it?'* approach. It is noted that the dual certificate of the Netherlands met with limited success and didn't seem to work in connection with modern ship operations.

The IMO and ILO system of engagement with stakeholders

The IMO could suggest a list of issues to the ILO to take up concerning the seafarer. In ILO the Joint Working Group of stakeholders on tripartite basis sit as equals in discussions and decision making. Within IMO the member states take precedence, and it is a bold ambition to make the shipping companies equal to other stakeholders. Within IMO decisions go back to the relevant committee/sub-committee, whereas within the ILO they go back to the governing body. The ILO and IMO are working closer to provide effective responses, policies, and guidance on the human element.

A better and stronger document is produced if it has gone through the tripartite process. Subsequently it needs to go to the legal committee for endorsement. With respect to the ITF, if workers support the document, then the owners tend to support it. Within the ILO, the governing body will respect the tripartite discussion and approve/endorse it. The respondent would like the IMO to elevate its conversation with seafarers and employers/owners to provide a balanced input to the discussions. *"I guess the IMO then will face a clamour from other stakeholders they allow to sit there – lobbyists, interest groups. This doesn't happen in ILO."* The technical structure of the IMO has affordances. The IMO Needs to reflect on how to engage with seafarers and owners.

View on MASS and technological development:

"MASS has become an acronym for a debate around full autonomy. They think it's basically a project to replace seafarers and the oceans will be littered with fully autonomous ships either acting independently or being controlled from ashore."

"Our individuals and our people have never been anti-technology when it enhances their experiences, when it makes them safer, when it makes them feel more protected. When it helps to protect the maritime environment seafarers, maritime professionals embrace technology."

"If they treat the automated systems the way they treat the humans, they will break down anyway and there would be no backup." Ships require maintenance for which crew is essential. Presently seafarers have lots of responsibilities with limited to no authority and are pressured to work like a robot. The narrative of sustainability of the industry with respect to a win-win situation for all is missing. With respect to discussions around just transition, decarbonisation, and new fuels, the narrative is around replacing humans with systems. *What is this going to cost and at what gain?* Needs to be asked.

The industry can see what they want to do/achieve with the MASS concept, however, will they be able to achieve full autonomy as indicated.

With respect to redundancies in the shipping industry

The respondent believes that a world without jobs for decent work for people is not a world that we would like to see. *"What are we all going to do? and how are we going to pay for our lives? and how are we going to afford to sustain ourselves and our families."*

"The compelling need should be directed towards not replacing the seafarer and making the operation of ships cheaper by removing the bit that costs the least. The compelling need should be to make the job better, easier, and diverse. We should remove the dangerous tasks that are quite onerous such as the enclosed spaces. Why should we send seafarers there."

Falsifying hours of work and rest has been seen in the industry and seafarers can work up to 91 hours a week in some circumstances. *"We should develop systems to support the seafarer to work less hours."*

With respect to communication technology:

Seafarers need social connectivity. They need to be provided communication technology or *"we won't to be able to recruit young people to go to sea"*. During arguments in international bargaining fora with respect to the provision of communication technology to ships' crew, the respondent finds it inconceivable that shipping companies do not see the value of technology provision as technology is embraced extensively in crew supplying countries, such as the Philippines, India, Bangladesh, and Indonesia. The crew need access to Wi-Fi to communicate with their family.

"This is the technology we need driven towards making the industry attractive, diverse, safer for the people on the ships and better for the environment."

The seafaring crew need contact; they need empathy; they need to be acknowledged, respected, they also require an opportunity for career progression.

The fallacious argument of human error:

The respondent believes that the argument of human error is fallacious as it does not consider the number of times when humans have saved the crew, vessel, and cargo from disasters. In the reports the human error is recorded and blamed when it wasn't the

individual at fault. The fault lay outside the individual while the individual ended up taking the lion's share of the blame.

Timelines of MASS development:

MASS will take time to become a reality. *"It is a long way off."*

Union involvement in IMO MASS instrument:

The union is involved in the development of the IMO MASS Instrument.

The union and national MASS regulations/policy:

The union is invited to the government's discussion table on national MASS policy/regulations.

Union and MASS policy:

The union does not have a MASS policy in those terms. However, they have produced a report along with other unions and submitted to the IMO. They have also conveyed their views through Maritime UK.

Union discussion with employers/shipping companies to develop MASS policy:

The union discusses MASS with employers, ship owners, and shipping companies. The union has discussed what the qualifications of remote operators would look like! As part of maritime UK, they were involved in developing guidance that influenced the Maritime 2050 document. Within this document, there is a people chapter that looks at jobs and skills for citizens in the industry; what it would take to be qualified seafarer/operator in the future. At the company level, discussions are taking place regarding what the future ship would be like. The innovation of technology is an ongoing conversation that the union has with the owners/employers.

The union would like collective discussions around policy and strategy.

Union engagement with other entities on MASS:

The union is engaged with the European Union through the ETF. It is involved in social dialogue as a partner in the Skill Sea project which also involves the future proofing of maritime skills. However other entities and the union are not really talking about MASS. The respondent would like the European Union to focus more on seafarers and coordinate their support for the cause of the seafarer.

As one goes further down the MASS road, the union would like to discuss with entities at the company level, industry level, national level, and the international level. The union would want to be involved loudly vocalising its concerns and being a part of the discussions until the regulatory situation is resolved sufficiently.

Final thoughts/recommendations:

The union wants a diverse force which is safe and wants to protect the environment.

"If decent work, well paid work for highly qualified seafarers is there in this industry for MASS operations, then we would want to be there and be part of it. We would like to shape those jobs and shape the working conditions under which one performs. No doubt, we will be at the table."

“In terms of MASS let's make sure MASS delivers for seafarers, make sure it delivers a just transition from the skills they have now to the skills they will need to be part of the maritime vision as I say with strong good jobs, with career prospects, decent salaries, opening opportunities for a diverse workforce and let's make sure that MASS delivers for seafarers in as much as it also delivers for the environment and for the operation of sustainable shipping.”

Appendix 15 – Joint interview 15 & 16 summary

Interviewee details:

Country	Experience
Hong Kong, China	Seafaring career >20 yrs (since 1972); Container terminal dockyard experience - 10 yrs; Lecturing & tutorial experience; Union member - 14 years
	High speed craft experience >30 yrs; Teaching/tutorial experience

Interview length: 53:09 minutes

Interview findings:

View on MASS:

Technological development that enables manpower to be reduced with each successive stage of MASS ship operations. It will take a long time to reach stage 4 of MASS operations. Customer service is important in the industry and manpower will continue to be required. Companies can lose business if there are no people onboard to take care of the cargo. MASS is not only about technology but also encompasses maritime service business that includes customer service and reliability. It would be difficult to trust a vessel without humans onboard. The owner and/or shipper (customer) may not like the idea of MASS.

The respondent (R1) could not imagine a ship without anyone onboard and believed that the stages were assumptions – *"I don't think it will happen."*

Importance of crew:

Crew is required onboard for maintenance and day to day operations and responding to emergency situations. Technological advancements have led to reduced manning onboard. From 52 crew in 1972 to 17-19 crew members currently, ships have seen a drastic reduction in onboard manpower. This has created a dangerous situation, particularly in the event of an emergency such as an accident, fire, or another emergency. Minimum manning is there to safeguard crewing requirements onboard. *"I don't think in the near future they can reduce any further."* Easily automatable jobs such as those of ratings could make them redundant and lead to further reduction of manpower. Currently there is work intensification onboard with a lot of work for a lesser number of crew to perform. If the ship is in danger and/or cargo could be lost at sea, someone should be onboard to deal with the situation or prevent it from occurring in the first place.

Technological advancements should be used to make the ship safer. Technology has led to several improvements onboard ships and have made the jobs better. The GPS has replaced the sextant; electronic charts have replaced paper charts and the direction finder is no longer required. However, despite the technological advancements, we still need human experience and knowledge to run the ship safely and the physical and psychological wellbeing of crew is extremely important.

Timelines of MASS development:

MASS will take time to become a reality.

Union involvement in IMO MASS instrument:

The union is not involved in the development of the IMO MASS Instrument. It would like the IMO to give a clear message and indication regarding the kind of manpower required to work at sea. The roles and responsibilities of the Master/crew/seafarers/operators need to be crystallised with respect to MASS. Without clarity, it is difficult to envisage the needs of the future and how to best meet those needs. Respondent 1 would like the IMO to send a positive message and make clear that there are still jobs at sea.

The union and national MASS regulations/policy:

The union is not invited to the government's discussion table on national MASS policy/regulations. The union would like the government to support the maritime trade union and highlight the pathway to keep abreast of the changes. They would like the government to give guidance to the industry regarding job security and putting in place an education and training plan. Since jobs are important to the economy the union would like the government to support the union. Communication between the union and the government is extremely important, therefore, the union would like an avenue/channel to communicate with the government and would like to be invited for a discussion.

Union and MASS policy:

Currently the union does not have a MASS policy, but it is being requested therefore work will be undertaken in that direction.

Union discussion with employers/shipping companies to develop MASS policy:

The union discusses MASS with employers, ship owners, and shipping companies. MASS is viewed as an opportunity to prepare for future jobs. Currently the narrative around MASS is *"too early, too much."* Currently, it is not viewed as a threat as there is an envisaged shortage of manpower in the near future. In addition to his official work, Respondent 1 aims to calm the union membership and assure them that they would have their jobs and should not worry. The union would like the employers to support them in providing job security, education and training and sharing future opportunities for the benefit of all.

Training for MASS:

There would be additional subjects for them to study. They would require their seafaring STCW training plus additional training in IT systems and similar to be ready to serve onboard MASS ships. Qualifications would need to be mapped to each stage to understand the training requirements. The entire curriculum would need to be adapted to the evolving needs of the maritime industry.

Union engagement with other entities:

The union currently does not engage with other entities in this matter. It needs a clear and better picture for its students and members. Thus far there is limited information and no interaction with other entities apart from employers.

Different pace of development and requirements of different world regions:

There is a different pace of MASS development in the different world regions as they have diverse and differing requirements. High technology may not be beneficial for all. The economically developed countries and/or resource rich big companies are moving first in this area. There are differing mindsets in the different world regions, and it is challenging to come to a consensus. There is an imbalance in the development of MASS in developed and developing countries and the industry needs to find a balance to make it work for all.

There is an uncertainty and anxiety in the industry regarding which stakeholders are responsible for the development! What will happen to the insurance market regarding liability and accountability?

Final thoughts/recommendations:

Information sharing enables diverse stakeholders of the maritime industry to gain clarity and work towards a common goal. Communication is extremely important, and the union would like stakeholders to share more information with them.

"The development of MASS should be for the safety of the crew, cargo, and the environment."

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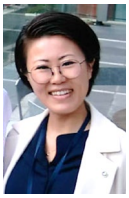

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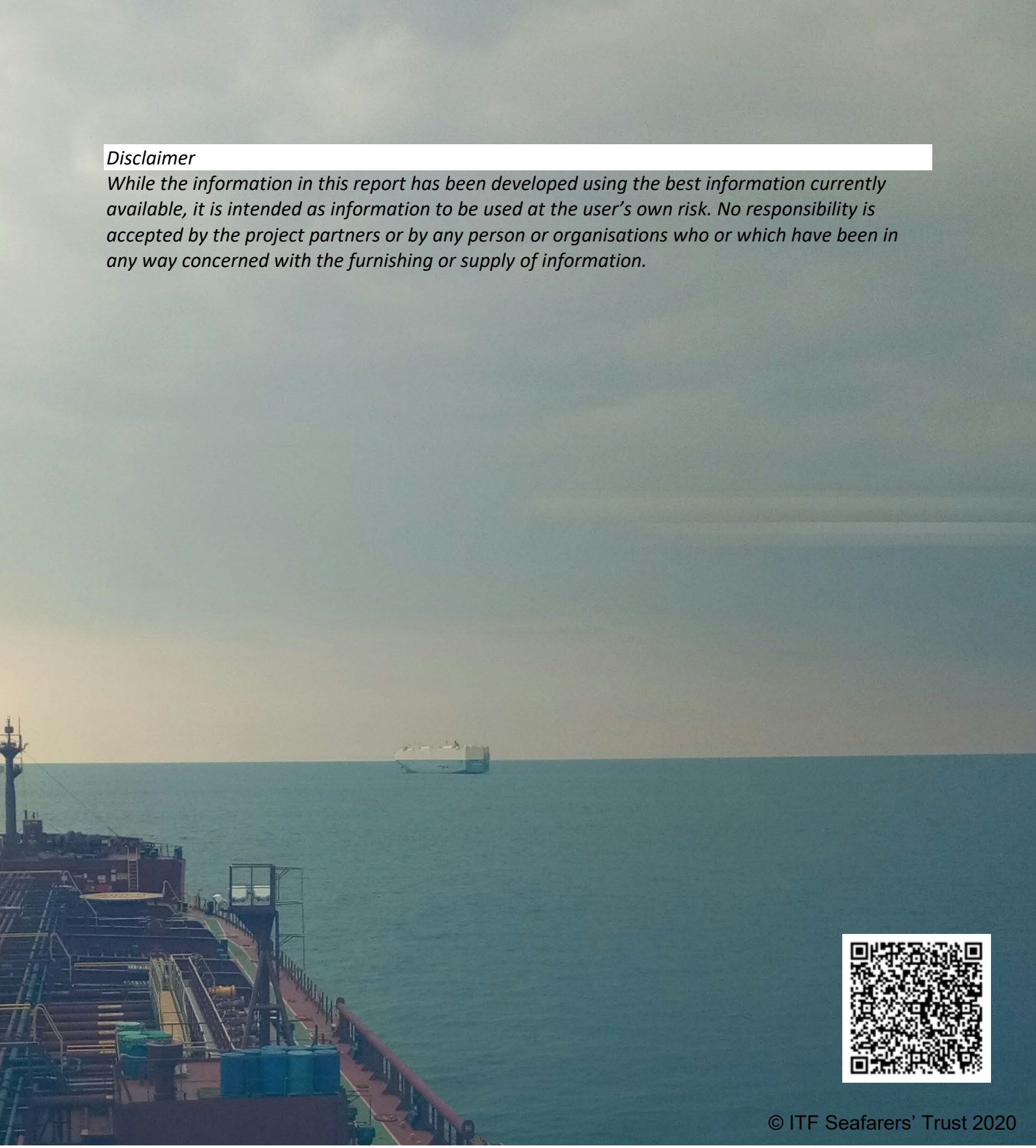

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