

A Study on the Implications of Maritime Autonomous Surface Ships on Maritime Education and Training

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ABSTRACT: Global maritime traffic is increasing, and the development of Maritime Autonomous Surface Ships (MASS) is progressing. The International Maritime Organization (IMO) is developing regulations for the introduction of MASS, and aims to issue a mandatory MASS Code in 2032. In preparation for the increasing realization of MASS, research on Maritime Education and Training (MET) based on International Convention on Standards of Training, Certification and Watchkeeping for seafarers, 1978 (STCW) is being conducted, however studies have not yet been carried out on the implications for MET as defined by various international regulations such as International Convention for the Safety of Life at Sea, 1974 (SOLAS) other than STCW. The purpose of this paper is to capture an overview of the changes in MET that are not limited to STCW in regards to the advent of MASS by conducting a questionnaire of professional seafarers in ocean shipping companies. Cooperation was obtained from 100 captains and deck officers to clarify this objective. An analysis of the survey results indicated that "Watchkeeping" was the most selected item for matters related to STCW. Other results showed that Safety Management System, which is specified in International Safety Management Code, and Ship Security Plan, which is specified in International Ship and Port Facility Security Code were major points of consideration for the respondents.

1 INTRODUCTION

Global maritime cargo volume increased from 9.48 billion tons in 2013 to 10.73 billion tons in 2023 (Japan Maritime Center, 2024). The operation of ships at sea is important to the world economy, and the seafarers who operate those ships are essential human resources. Research and development, including demonstration testing, is being actively conducted in Japan and around the world with the aim of improving the safety and efficiency of maritime transport, reducing the burden on seafarers, addressing the shortage of seafarers, and reducing costs concerning the practical application of Maritime Autonomous Surface Ships (MASS) (AAWA, 2016; European Commission, 2017;

The Nippon Foundation, 2022a; The Nippon Foundation, 2022b; YARA, 2024).

To deal with the development of MASS around the world, the International Maritime Organization (IMO), the international maritime rule-making body, is actively discussing the development of legal systems and international standards (IMO, 2023). At IMO, the Maritime Safety Committee (MSC), which is in charge of safety matters, plays a central role in the study of MASS. At MSC 98 in 2017, it was decided to conduct a 'Discussion Paper on Regulations for the Use of MASS.' A Regulatory Scoping Exercise (RSE) was initiated to determine whether the current IMO regulations require amendments and other measures (IMO, 2017).

The following year, MSC 100 defined the following four levels of MASS (IMO, 2018).

- Degree1: Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.
- Degree2: 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.
- Degree3: Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board.
- Degree4: Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself.

At MSC 109 in 2024, the roadmap for the development of the MASS Code was revised, with the aim of adopting a mandatory MASS Code on July 1st, 2030, to enter into force on January 1st, 2032 (IMO, 2024).

Kretschmann et. al. (2017) point out that onboard labor costs can account for up to 36% of all costs. The Nautilus Federation (2018) also concluded that training and retraining are among the biggest barriers to MASS implementation. It is socially significant to conduct research on the education and training of seafarers, which is very costly for the safe operation of ships. Fan et. al. (2020) point out that lack of training is a factor affecting the operational risk of MASS. In addition, future seafarers, or cadets, are interested in shipboard automation (Boguslawski et. al., 2024), and it is important to consider a Maritime Education and Training (MET) curriculum that will effectively train them under the changing paradigms. In addition, the roles and responsibilities of future seafarers have been identified as one of the most complex issues to be addressed in the adoption of the MASS in MSC 103 in 2021 (IMO, 2021).

Aylward et. al. (2022) point out that education and training in “nautical knowledge” is essential while seafarers are on board and have decision-making authority, and Yoshida et. al. (2020) propose a framework for Remote Operator (RO) competence under International Convention on Standards of Training, Certification and Watchkeeping for seafarers, 1978 (STCW). As these two studies show, there is a need to consider MET curriculum regardless of whether seafarers are on board or not. Sharma et. al. have conducted a study of experts to ascertain the importance of seafarer competency standards to MASS. Kim and Mallan (2020) also conducted a study of seafarers' attitudes toward MASS, primarily among experienced seafarers. On the other hand, Mallan et. al. (2022) focused on the opinions of academics. Training-related issues were mentioned on other occasions, indicating a gap between the future shape of the industry and training methods (Pietrzykowski and Hajduk, 2019; Hogg and Ghosh, 2016). Most of these previous studies are based on STCW. However, consideration should also be given to MET other than those under STCW. Examples are international regulations such as International Convention for the

Safety of Life at Sea, 1974 (SOLAS), International Convention for the Prevention of Pollution from Ships (MARPOL), International Safety Management (ISM) Code, and International Ship and Port Facility Security (ISPS) Code. Therefore, the purpose of this paper is to provide an overview of the changes in STCW and MET stipulated in various international regulations with the advent of MASS by conducting a questionnaire survey of professional seafarers of ocean shipping companies.

2 METHODS

A questionnaire about MASS and MET was administered between October 2023 and March 2024 to a total of 101 respondents from 3 companies, consisting of 43 Japanese and 10 non-Japanese seafarer employees from shipping company A, 14 Japanese and 1 non-Japanese seafarer employees from shipping company B, and 20 Japanese and 14 non-Japanese seafarer employees from shipping company C. No personally identifiable information was collected in the questionnaire. The purpose of the questionnaire was to identify the current image of MET with the emergence of MASS among professionals in the field, to examine current MET for MASS operations based on the maritime professionals' practical experience onboard and onshore, and to identify potential areas for MET changes. The questionnaire was divided into two sections, Degrees 1 and 2 with people on board, and Degrees 3 and 4 without people on board, with questions on STCW (Table A- II /1 Specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more Column2 Focusing on 22 themes of knowledge, understanding and proficiency) and MET as defined in various international regulations, including STCW. In addition, questions regarding MET as defined by various international regulations were investigated at three separate times: “throughout the year,” “immediately prior to embarkation,” and “onboard.” The questions were prepared based on “Introduction to Ship Management: A practical guide to ship management.” (The Japan Shipping Exchange, Inc., 2008).

There were 101 respondents, 100 of whom agreed to complete the questionnaire. Of the respondents, 83 were active captains and chief officers of ocean-going vessels, 21 of whom were non-Japanese. Table 1 shows the age of respondents. Table 2 shows the license type held by the 100 respondents. 72.0% hold a grade 1 license. Table 3 shows onboard experience of respondents. 67% have more than 8 years experience at sea. These data points provide evidence of the high level of expertise and experience of the respondents. Table 4 and Table 5 show the years of onshore experience and the departments in which they have worked, respectively. Nearly 90% of respondents have worked onshore, in a wide range of departments. Therefore, the respondents provided perspectives that were obtained not only from working at sea, but also from working onshore. The responses in Table 5 show the percentages for the 88 respondents who have worked onshore.

Table 1. The age of respondents

Age	20-29	30-39	40-49	50-59	60-64	over 65
No. of respondents (%)	7 (7.0%)	36 (36.0%)	30 (30.0%)	27 (27.0%)	0 (0.0%)	0 (0.0%)

Table 2. License type of respondents

License	First*1	Second*2	Third*3
No. of respondents (%)	72 (72.0%)	23 (23.0%)	5 (5.0%)

Note: *1: ocean going master mariner; *2: ocean going chief class; *3: ocean going second and third class

Table 3. Onboard experience of respondents

Year	1-3	4-7	8-10	11-15	16-20	20 +
No. of respondents (%)	4 (4.0%)	29 (29.0%)	17 (17.0%)	2 (2.0%)	15 (15.0%)	8 (8.0%)

Table 4. Onshore experience of respondents

Year	Nothing	1-3	4-7	8-10	11-15	16-20	20 +
No. of respondents (%)	12 (12.0%)	26 (26.0%)	20 (20.0%)	15 (15.0%)	15 (15.0%)	12 (12.0%)	0 (0.0%)

Table 5. Department of onshore

Deployments	No. of respondents (%)
Human Resources	20 (22.7%)
Public Relations	3 (3.4%)
Harbor	4 (4.5%)
Offshore Business	5 (5.7%)
Environment	3 (3.4%)
Marine	48 (54.5%)
Technical	5 (5.7%)
Energy	15 (17.0%)
Car carrier	12 (13.6%)
Container	13 (14.8%)
Dry Bulk	13 (14.8%)
LNG	17 (19.3%)
Others	32 (36.4%)
Total	190

Note: Multiple selections allowed

In the following chapters, we will analyze the results of the questionnaire survey and discuss the possible changes in MET due to the emergence of MASS.

3 RESULTS

3.1 STCW

We asked the following question regarding the availability of changes in STCW at MASS automation levels Degrees 1 and 2 as well as Degrees 3 and 4. We asked the question "Please select the items in which you think there will be changes regarding STCW (minimum competency standards for personnel on deck duty on vessels of 500 gross tons or more)." In order to separately represent those who responded, respondents who selected "No particular changes" and those who selected the change items are shown in Tables 6 and 7.

Table 6. Availability of changes in STCW (Degree1 and Degree2)

Answer	There will be changes.	No particular changes.	Total
No. of respondents (%)	79 (79.0%)	21 (21.0%)	100 (100.0%)

In Table 6, 79 (79.0%) of the respondents stated that there will be changes, while 21 (21.0%) of the respondents stated that no particular changes.

Table 7. Availability of changes in STCW (Degree3 and Degree4)

Answer	There will be changes.	No particular changes.	Total
No. of respondents (%)	75 (75.0%)	25 (25.0%)	100 (100.0%)

In Table 7, 75 (75.0%) of the respondents stated that there will be changes, while 25 (25.0%) of the respondents stated that they expect no particular changes. The change items in Degrees 1 and 2 and Degrees 3 and 4 are shown in Table 8. Table 8 shows the percentages for the 79 (Degrees 1 and 2) and 75 (Degrees 3 and 4) respondents who responded, "There will be changes."

Table 8. Changes in STCW

Answer	(Deg.1&2) No. of respondents (%)	(Deg.3&4) No. of respondents (%)
Celestial Navigation	33 (41.8%)	38 (50.7%)
Terrestrial and coastal navigation	29 (36.7%)	34 (45.3%)
Electronic systems of position fixing and navigation	28 (35.4%)	26 (34.7%)
Echo sounding	10 (12.7%)	18 (24.0%)
Compass-magnetic and gyro	15 (19.0%)	21 (28.0%)
Steering control system	31 (39.2%)	31 (41.3%)
Meteorology	21 (26.6%)	19 (25.3%)
Watchkeeping	51 (64.6%)	45 (60.0%)
Radar navigation	33 (41.8%)	31 (41.3%)
Navigation using ECDIS	41 (51.9%)	33 (44.0%)
Emergency procedures	40 (50.6%)	41 (54.7%)
Search and rescue	28 (35.4%)	34 (45.3%)
English language	14 (17.7%)	11 (14.7%)
Visual signaling	20 (25.3%)	19 (25.3%)
Ship maneuvering and handling	43 (54.4%)	45 (60.0%)
Cargo handling, stowage and securing	18 (22.8%)	27 (36.0%)
Prevention of pollution of the marine environment and air-pollution procedures	15 (19.0%)	21 (28.0%)
Ship stability	13 (16.5%)	17 (22.7%)
Ship construction	16 (20.3%)	27 (36.0%)
Fire prevention and fire-fighting appliances	25 (31.6%)	32 (42.7%)
Life saving	25 (31.6%)	32 (42.7%)
Medical aid	19 (24.1%)	26 (34.7%)
Total	568	628

Note: Multiple selections allowed

In Degrees 1 and 2, the three most frequent responses were, in descending order, 51 responses (64.6%) for "Watchkeeping", 43 responses (54.4%) for "Ship maneuvering and handling" and 41 responses (51.9%) for "Navigation using ECDIS." In Degrees 3 and 4, the three most frequent responses were, in descending order, 45 responses (60.0%) for "Watchkeeping" and "Ship maneuvering and handling", 41 responses (54.7%) for "Emergency procedures." The total number of itemized change was 568 in Degrees 1 and 2, and 628 items in Degrees 3 and 4, an increase of 60 items (10.6%).

3.2 MET by various international regulations

3.2.1 Throughout the year

We asked the following question regarding the availability of changes in MET throughout the year at MASS automation levels Degrees 1 and 2 as well as Degrees 3 and 4. We asked the question “Please select the items you expect to change regarding throughout the year education/training.” In order to separately represent those who responded, respondents who selected “No particular changes” and those who selected the change items are shown in Tables 9 and 10.

Table 9. Availability of changes in MET throughout the year (Degree1 and Degree2)

Answer	There will be changes.	No particular changes.	Total
No. of respondents	81 (81.0%)	19 (19.0%)	100
(%)			(100.0%)

In Table 9, 81 (81.0%) of the respondents stated that there will be changes, while 19 (19.0%) of the respondents stated that no particular changes are anticipated.

Table 10. Availability of changes in MET throughout the year (Degree3 and Degree4)

Answer	There will be changes.	No particular changes.	Total
No. of respondents	72 (72.0%)	28 (28.0%)	100
(%)			(100.0%)

In Table 10, 72 (72.0%) of the respondents stated that there will be changes, while 28 (28.0%) of the respondents stated that no particular changes. The change items in Degrees 1 and 2 and Degrees 3 and 4 are shown in Table 11. Table 11 shows the percentages for the 81 (Degrees 1 and 2) and 72 (Degrees 3 and 4) respondents who responded, “There will be changes.”

Table 11. Changes in MET throughout the year

Answer	(Deg.1&2) No. of respondents (%)	(Deg.3&4) No. of respondents (%)
ISM Code/SMS (Safety Management System) related matters	55 (67.9%)	59 (81.9%)
ISPS Code / SSP (Ship Security Plan) related matters	45 (55.6%)	51 (70.8%)
Training and certification based on STCW	57 (70.4%)	60 (83.3%)
Items related to the MARPOL and global environmental pollution prevention	23 (28.4%)	32 (44.4%)
Maritime regulations, ship operation, equipment handling, general and recent topics in shipping, and other matters specified by ship management companies	65 (80.2%)	61 (84.7%)
Total	245	263

Note: Multiple selections allowed

In Degrees 1 and 2, the three most frequent responses were, in descending order, 65 responses (80.2%) for “Maritime regulations, ship operation,

equipment handling, general and recent topics in shipping, and other matters specified by ship management companies”, 57 responses (70.4%) for “Training and certification based on STCW” and 55 responses (67.9%) for “ISM Code/SMS (Safety Management System) related matters.” In Degrees 3 and 4, the three most frequent responses were, in descending order, 61 responses (84.7%) for “Maritime regulations, ship operation, equipment handling, general and recent topics in shipping, and other matters specified by ship management companies”, 60 responses (83.3%) for “Training and certification based on STCW” and 59 responses (81.9%) for “ISM Code/SMS (Safety Management System) related matters.” The total number of itemized change was 245 in Degrees 1 and 2, and 263 items in Degrees 3 and 4, an increase of 18 items (7.3%).

3.2.2 Immediately prior to embarkation

We asked the following question regarding the availability of changes in MET immediately prior to embarkation at MASS automation levels Degrees 1 and 2 as well as Degrees 3 and 4. We asked the question “Please select the items you expect to change regarding education/training immediately prior to embarkation.” In order to separately represent those who responded, respondents who selected “No particular changes” and those who selected the change items are shown in Tables 12 and 13.

Table 12. Availability of changes in MET immediately prior to embarkation (Degree1 and Degree2)

Answer	There will be changes.	No particular changes.	Total
No. of respondents	78 (78.0%)	22 (22.0%)	100
(%)			(100.0%)

In Table 12, 78 (78.0%) of the respondents stated that there will be changes, while 22 (22.0%) of the respondents stated that no particular changes were expected.

Table 13. Availability of changes in MET immediately prior to embarkation (Degree3 and Degree4)

Answer	There will be changes.	No particular changes.	Total
No. of respondents	78 (78.0%)	22 (22.0%)	100
(%)			(100.0%)

In Table 13, 78 (78.0%) of the respondents stated that there will be changes, while 22 (22.0%) of the respondents stated that no particular changes were expected. The change items in Degrees 1 and 2 and Degrees 3 and 4 are shown in Table 14. Table 14 shows the percentages for the 78 (Degrees 1 and 2) and 78 (Degrees 3 and 4) respondents who responded, “There will be changes.”

Table 14. Changes in MET immediately prior to embarkation

Answer	(Deg.1&2) No. of respondents (%)	(Deg.3&4) No. of respondents (%)
Basic pre-boarding training required by STCW	41 (52.6%)	47 (60.3%)
Proficiency training required by STCW	49 (62.8%)	51 (65.4%)
International regulations, SMS, SSP, and other company regulations	48 (61.5%)	51 (65.4%)
Ship's particulars, routes, special matters, and pending issues	40 (51.3%)	49 (62.8%)
Recent accidents and matters requiring special attention (including accident procedures)	48 (61.5%)	49 (62.8%)
Key points and points to be noted in charter contracts, insurance contracts, manning contracts, collective bargaining agreements, etc. (including ITF measures)	27 (34.6%)	36 (46.2%)
Other matters requested by ship management companies, shipowners, charterers, etc.	30 (38.5%)	38 (48.7%)
Total	283	321

Note: Multiple selections allowed

In Degrees 1 and 2, the three most frequent responses were, in descending order, 49 responses (62.8%) for "Proficiency training required by STCW", 48 responses (61.5%) for "International regulations, SMS, SSP, and other company regulations" and "Recent accidents and matters requiring special attention (including accident procedures)." In Degrees 3 and 4, the three most frequent responses were, in descending order, 51 responses (65.4%) for "Proficiency training required by STCW" and "International regulations, SMS, SSP, and other company regulations", 49 responses (62.8%) for "Ship's particulars, routes, special matters, and pending issues" and "Recent accidents and matters requiring special attention (including accident procedures)." The total number of itemized change was 283 in Degrees 1 and 2, and 321 items in Degrees 3 and 4, an increase of 38 items (13.4%).

3.2.3 Onboard

We asked the following question regarding the availability of changes in MET onboard at MASS automation levels Degrees 1 and 2 as well as Degrees 3 and 4. We asked the question "Please select the items you expect to change regarding onboard education and training. (Multiple selections allowed)" In order to separately represent those who responded, respondents who selected "No particular changes" and those who selected the change items are shown in Tables 15 and 16.

Table 15. Availability of changes in MET onboard (Degree1 and Degree2)

Answer	There will be changes.	No particular changes.	Total
No. of respondents (%)	78 (78.0%)	22 (22.0%)	100 (100.0%)

In Table 15, 78 (78.0%) of the respondents stated that there will be changes, while 22 (22.0%) of the respondents stated that no particular changes were anticipated.

Table 16. Availability of changes in MET onboard (Degree3 and Degree4)

Answer	There will be changes.	No particular changes.	Total
No. of respondents (%)	75 (75.0%)	25 (25.0%)	100 (100.0%)

In Table 16, 75 (75.0%) of the respondents stated that there will be changes, while 25 (25.0%) of the respondents stated that no particular changes. The change items in Degrees 1 and 2 and Degrees 3 and 4 are shown in Table 17. Table 17 shows the percentages for the 78 (Degrees 1 and 2) and 75 (Degrees 3 and 4) respondents who responded, "There will be changes."

Table 17. Changes in MET onboard

Answer	(Deg.1&2) No. of respondents (%)	(Deg.3&4) No. of respondents (%)
Shipboard Familiarization required by STCW	55 (70.5%)	57 (76.0%)
Various drills	37 (47.4%)	41 (54.7%)
Safety Management Policy	48 (61.5%)	53 (70.7%)
SSP related matters	43 (55.1%)	45 (60.0%)
Safety and health training	33 (42.3%)	44 (58.7%)
Special requests and instructions from ship management companies, shipowners and charterers.	41 (52.6%)	43 (57.3%)
Port conditions at ports of call, cargo and cargo handling conditions, and other precautions	32 (41.0%)	42 (56.0%)
Other information on terrorism and piracy, danger information, ITF circumstances	35 (44.9%)	40 (53.3%)
Total	324	365

Note: Multiple selections allowed

In Degrees 1 and 2, the three most frequent responses were, in descending order, 55 responses (70.5%) for "Shipboard Familiarization required by STCW", 48 responses (61.5%) for "Safety Management Policy" and 43 responses (55.1%) for "SSP related matters." In Degrees 3 and 4, the three most frequent responses were, in descending order, 57 responses (76.0%) for "Shipboard Familiarization required by STCW", 53 responses (70.7%) for "Safety Management Policy" and 45 responses (60.0%) for "SSP related matters." The total number of itemized change was 324 in Degrees 1 and 2, and 365 items in Degrees 3 and 4, an increase of 41 items (12.7%).

4 DISCUSSION

The above results give an indication of the appearance of changes in MET due to the advent of MASS, as considered by professional seafarers. As can be seen from Tables 6 and 7, approximately 80% of professional seafarers considered that STCW would change with the advent of MASS. From Table 9, Watchkeeping was the most frequently selected item for possible change. The criteria for assessing this competence include "The conduct, handover and relief of the watch conforms with accepted principles and procedures" and "A proper lookout is maintained at all times and in such a way as to conform to accepted principles and procedures." Whatever the level of MASS, be it as a system with automatic navigation functions, remote operation or fully autonomous operation, it is expected to be a change from the current system of navigation watch. "Watchkeeping" competence assessment

criteria are also likely to change as a result of changes to navigation watch. On the other hand, in Tables 6 and 7, approximately 20% selected “No particular changes.” It can be inferred that professional seafarers suspect that the emergence of automated vessels will not significantly change what is required of seafarers or ROs in terms of competence. For each of these items, it is expected that the current broad themes will be maintained, although looking at the details there may be items to be added or deleted. Pietrzykowski and Hajduk (2019) point out that theoretical training does not face many problems; it is practice that faces problems. If the deployment of seafarers is reduced with the advent of MASS, it is expected that seafarers will have less experience at sea. However, there are some things that can only be experienced at sea, such as the distance from other vessels that you can actually feel with your own body, external forces such as wind that the hull is subjected to, and the resulting hull motions. Without these experiences at sea, any problems with a remotely operating vessel could result in a delayed response. Yoshida et al. (2020) also point out that “experience” is an important item to compensate for lack of ship sense and necessary information. Even if MASS with no seafarers on board emerge, as in IMO Degrees 3 and 4, it may be necessary to work at sea for a certain period of time and experience what can only be experienced at sea.

In terms of MET as defined in various international regulations, Tables 9 and 10 show that 81% (Degrees 1 and 2) and 72% (Degrees 3 and 4) responded that there will be changes in regard to MET throughout the year. Table 11 shows that the most frequently selected items for change were “Maritime regulations, ship operation, equipment handling, general and recent topics in shipping, and other matters specified by ship management companies.” Tables 12 and 13 show that 78% of the respondents answered “There will be changes” with regard to MET immediately prior to embarkation, regardless of the level of MASS. Table 14 shows that the change items are “Proficiency training required by STCW” in Degrees 1 and 2, “Proficiency training required by STCW” and “International regulations, SMS, SSP, and other company regulations” in Degrees 3 and 4 were the most frequently selected items. Tables 15 and 16 show that 78% (Degrees 1 and 2) and 75% (Degrees 3 and 4) responded that there will be changes in regard to MET onboard. Table 17 shows that the most frequently selected items for change were “Shipboard Familiarization required by STCW.” Other items selected for change were not only matters relating to STCW, but also in regard to SMS as specified in the ISM Code and SSP as specified in the ISPS Code. MET curricula are not only those outlined by STCW. Future consideration should not be limited to STCW, but also with consideration to MET as provided for in various international regulations or company rules.

Fewer people selected “There will be changes” in Degrees 3 and 4, which no people are on board, than in Degrees 1 and 2, which people are on board in most responses. This result is thought to be due to the fact that it is difficult for professional seafarers to imagine a situation where no one is on board the vessel in this survey.

5 CONCLUSION

In this study, 100 professional seafarers were surveyed to provide an overview of how the MET is changing with the advent of MASS. In regard to the survey items in this questionnaire - STCW and MET stipulated in various international regulations - more than 70% of professional seafarers respectively believe that there will be changes. The study showed possible changes to the competence requirements set out in STCW. For MET defined by various international regulations, a number of options related to STCW were selected, but also items related to MET defined by the ISM Code and the ISPS Code. In the future, a detailed study should also be carried out on MET provided for in international regulations other than STCW (e.g. which parts of the SMS as provided for in the ISM Code need to be changed).

This study did not examine how changes should be made in regard to individual items in order to provide an overview of changes. In addition, questionnaires were used in this study, but questionnaire surveys have limitations in the response results obtained as they do not allow for a deep dive into the results of the responses. To conduct a detailed study of how each of these items may change, it is necessary to conduct interviews or use other methods than surveys, e.g. by conducting interviews.

ACKNOWLEDGEMENTS

The authors wish to thank the participants from NYK Line (Nippon Yusen Kabushiki Kaisha), MOL (Mitsui O.S.K. Lines, Ltd.) and K Line (Kawasaki Kisen Kaisha, Ltd.) for responding to their MASS survey. This work was supported by JST SPRING, Grant Number JPMJSP2148.

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