

Basic Research on the Establishment of a Standardization Roadmap of Maritime Autonomous Surface Ship (MASS)

Joo-Young JEON* and Jeong-Bin YIM**

*International Standards Team, Korea Marine Equipment Research Institute, Republic of Korea

jyjeon@komeri.re.kr

** Division of Navigation Convergence Studies, Korea Maritime and Ocean University, Busan, Korea Republic

jbyim@kmou.ac.kr

Key words: MASS, Standardization, ISO, IEC, Ship and Marine Technology

ABSTRACT

The need for international standard development has been raised based on the results of many studies that the development of Maritime Autonomous Surface Ship(MASS) progressed actively around the world and economic effects can be obtained by using standards. In this study, in order to develop a standardization roadmap required in the field of MASS, the standards published or under development in the field of International Organization for Standardization (ISO) Technical Committee 8, Ships and Marine Technology were analyzed. In addition, by analyzing the existing reports and research results, the performance of MASS related technologies was classified into five categories: situational awareness, intelligent navigation, remote control, ship operation, and port support. The analysis results and technical classification in this study were evaluated and verified through a meeting composed of experts in the relevant field. For further studies the mid- to long-term planning of standardization will be proceeded.

1. Introduction

As research and development of Maritime Autonomous Surface Ships (MASS) become active, the development of various regulations and standards is required. Derived from these requirements, at the 105th session of the IMO Maritime Safety Committee held in April 2022, it was agreed to develop the nonmandatory code for MASS as a temporary measure before the compulsory MASS Code development, and a roadmap work plan was established until the 109th Maritime Safety Committee ('24). The Correspondence Group was also established to review the details such as the purpose, scope, main principles, table of contents, and definitions of the nonmandatory code for MASS. (IMO MSC 105)

As autonomous ship related technologies are introduced, technologies that contradict those currently regulated by the IMO will be developed, and the standards can be strategically used as there is a limit to deal with the details in related regulations. A method to verify autonomous ship technology before the time the agreement is completed and entered into force is presented as a standard, and then it can be adopted as a reference standard in consultation with the IMO. Standardization affects both innovation and technology spread to the market and industry. Standardization during the life cycle of a technology affects economic efficiency. Standardization can increase efficiencies within a technology lifecycle, but it can also overextend existing lifecycles by restraining investments in technological innovations that generate the next one(Tassey G.,2000). The relation between life cycle of technology development and standardization are deeply related as described in Figure 1. It is divided into the stage of technical research, the stage of industry development and the stage of market maturity. The standardization process begins with the technical research and standard proposals are to be unveiled in an earlier stage of the product's lifecycle(Li, 2020).

The Technical committee 8, Ship and Marine Technology within the ISO designates ocean-going vessels, inland navigational vessels, offshore structures, ship-to-shore interfaces, and other offshore structures in accordance with IMO requirements, including shipbuilding and ship navigation. It is responsible for the development of standards related to construction, structure, equipment, equipment, methods, technology, and marine environment (iso.org/home/tc8). Currently, 399 standards published in TC8 and 88 standards under development are participating members. of 27 and 22 Observing members. The ISO TC8 structure is shown in Figure 2. The secretariat and the chair country were marked with their national flags.

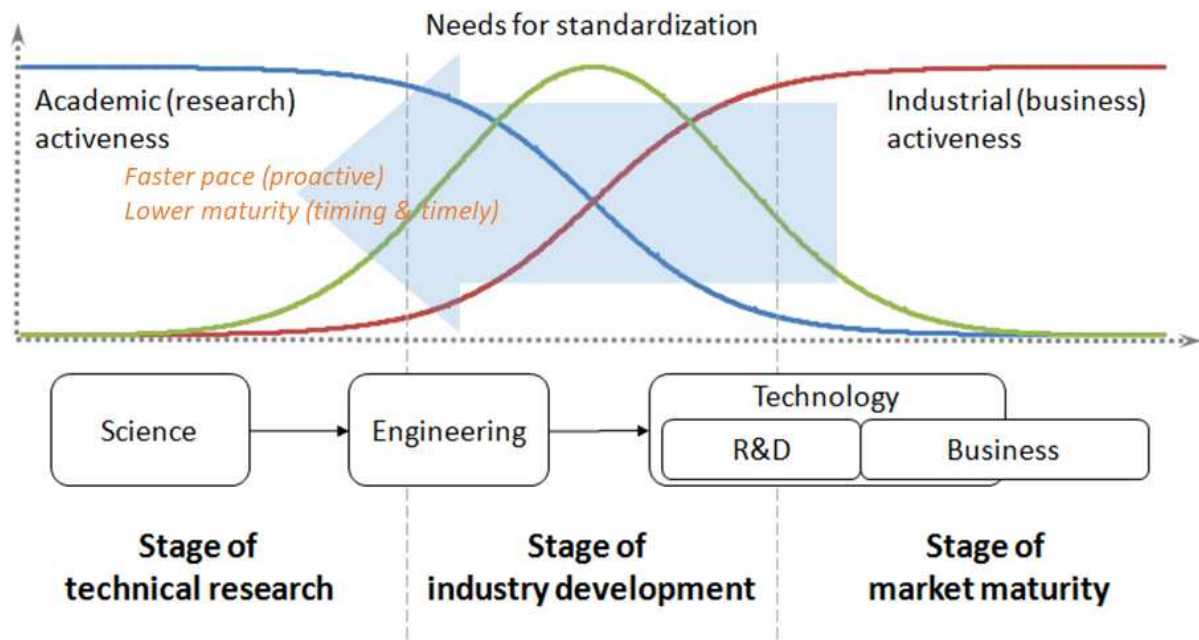


Figure 1. Correlation between technology life cycle and standardization

Currently, MASS-related technologies are developing standards in the following technical divisions and working groups(WG) indicated by the red border in Figure 1.

- ISO TC8 SC6 navigation and ship operation
- ISO TC8 SC11 Intermodal and Short Sea Shipping
- ISO TC8 WG4 Cybersecurity
- ISO TC8 WG10 Smart Shipping

TC-level WG is an ad hoc group set up for specific tasks to timely handle emerging demands.

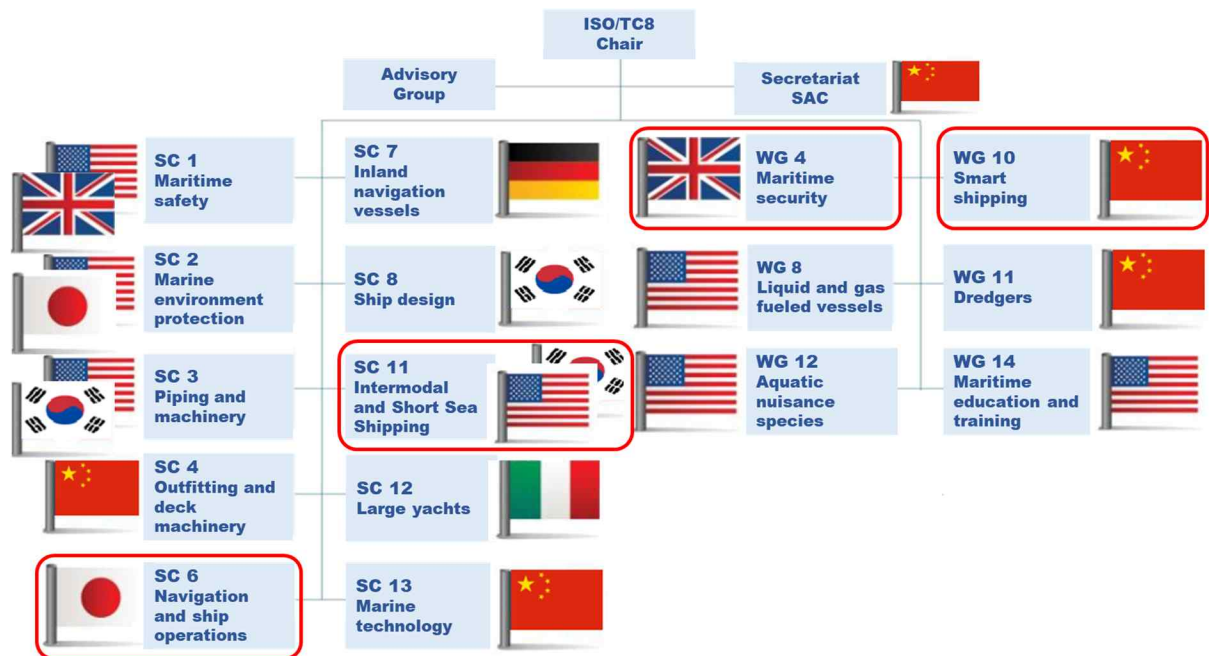


Figure 2. Structure of ISO/TC8

2. Method

For the development of a roadmap for standardization of autonomous ships, we investigate trends in autonomous ships, analyze existing reports, define target technologies, review ISO standards and IEC standards that have been developed or are currently under development, and apply to the scope covered by each standard. was analyzed. The development method and process of this is shown in Figure 3.

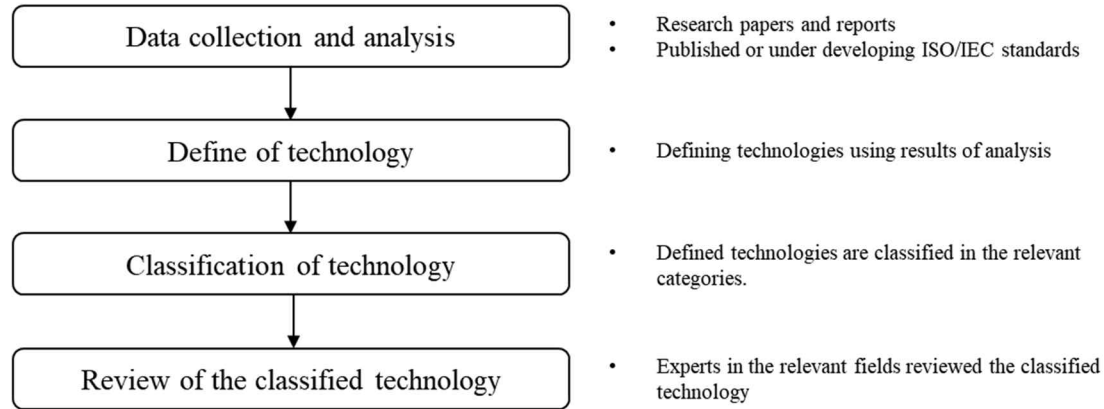


Figure 3. Process of this study

3. Results and Discussions

Main technologies were analyzed based on existing research papers and reports on autonomous ships. In this study we have analyzed the main 16 standards which was published or under development by ISO TC8 and 17 standards developed in IEC TC80 (Maritime navigation and radiocommunication equipment and systems). The main standards developed by ISO are summarized as follows. See Table 1.

The standard development in the overall navigation field including navigation equipment and systems in ship operation. For ship data server related the Smart ship application platform (SSAP) project group was formed in Japan and the design and implementation of the shipboard data server (SDS) and ship data center (Ship DC), and the ship-land platform, etc. were studied. ISO 19847, 19848, 23807 were proposed to develop in WG16 (Ship Communication Network System) and WG 10(Smart Shipping).

The ISO 19847 standard is a standard for shipboard data servers mounted on ships, and includes communication protocols, server system specifications, and performance specifications. The ISO 19848 standard defines a standard data model required for software implementation to collect, process, and process sensor data of ship-mounted equipment. ISO 23807 standard standardizes communication model between ship and shore. In the smart ship platform business promoted by the three shipbuilding companies in cooperation in Korea, it is basically related to the ISO 19847/19848/23807 standard, and the development of a competitive standard model is prioritized.

For the standard developed in ISO/TC8/SC11 (Intermodal and Short Sea Shipping), it mainly deals with ship/voyage interface, transport mode, offshore transport, and marine transport barge, but as smart ships have recently become an issue, interface and software related projects between ships and land are in progress. The ISO 21745 standard was developed and published as the movement to electronically make documents used on ships easier to check and store documents in accordance with changing communication and technological environment changes in earnest, standardization of automatic management for preventive maintenance of onboard engines as well as operation-related electronic logbooks.

The ISO 24060 is about software ship software logging system (SSLS) for logging and retrieving software version information and current operational status. Standard for marine trial operation and preliminary verification based on the draft SW maintenance/repair verification procedure standard by relevant organizations such as BIMCO and IACS for collision prevention and compatibility verification between SWs installed on inboard navigation/engineering equipment.

As different systems are connected to onboard devices and servers, it is necessary to prepare countermeasures for failure messages and blackouts due to software conflicts. Accordingly, the standard related to the electronic service report in the form of verification and continuous reporting on whether it can be continuously operated on the ship's computer software is being developed.

Table 1. Status of the standards developed in ISO/TC8 regarding MASS technology

ISO/SC/WG	ISO No.	Title	Proposal nationality	Publish year/Stage
TC8/WG10	23860	Terminology related to autonomous ship systems	Norway	2022
TC8/WG 4	23806	Cyber safety	UK	PRF
TC8/WG10	4891	Interoperability of smart applications for ship	Germany	CD
TC8/WG10	23807	General requirements for the asynchronous time-insensitive ship-shore data transmission	Japan	DIS
TC8/WG10	23816	Secured ship network based on IPv6 Ethernet network	Korea	AWI
TC8/WG10	18131	General requirements for publish-subscribe architecture on ship-shore data communication	Korea	AWI
SC6/WG16	16425	Specification for the installation of ship communication networks for shipboard equipment and systems	Japan	CD
SC6/WG16	19847	Shipboard data servers to share field data at sea	Japan	CD
SC6/WG16	19848	Standard data for shipboard machinery and equipment	Japan	CD
SC 11	21745	Electronic record books for ships — Technical specifications and operational requirements	Norway	2019
SC11/WG3	23323	Specification for software-based planned maintenance systems	Korea	2021
SC11/WG3	24060	Ship software logging system for operational technology	US	2021
SC11/WG3	24060-2	Ship software logging system for operational technology — Part 2: Electronic service reports	US	AWI
SC 11	28005-1	Electronic port clearance (EPC) — Part 1: Application protocol interface and message structures	Norway	CD
SC11/WG2	28005-2	Electronic port clearance (EPC) — Part 2: Core data elements	Norway	2021
SC11/WG2	28005-3	Electronic port clearance (EPC) — Part 3: Part 3: Technical standard for administrative and operational data exchanges (port call optimization)	Norway	AWI

4. Conclusion

As a result of analyzing the standards developed in ISO TC8, standards related to smart ships are being developed in the SC6 (Sailing and Ship Management), SC11 (Combined Transport and Batch Transport), and WG10 (Smart Ship) divisions within ISO TC8. In the field of ISO TC8, smart technologies in ports and ships are being actively carried out mainly in European countries, but compared to the degree of technology development, international standardization development is insufficient. As of 2022, communication network and security system related standards development among smart ships is being actively carried out.

Further study will be proceed based on the analysis of this study to develop standardization roadmap in regard of MASS.

Acknowledgements

This research was supported by the 'Development of Autonomous Ship Technology (20200615)' funded by the Ministry of Oceans and Fisheries (MOF, Korea).

References

- (1) DNVGL-CG (2018) : Autonomous and remotely operated ships, Class guideline — DNVGL-CG-0264.
- (2) ISO/CD 16425 Ships and marine technology — Standard data for shipboard machinery and equipment
- (3) ISO/CD 19847 Ships and marine technology — Specification for the installation of ship communication networks for shipboard equipment and systems
- (4) ISO/CD 19848 Ships and marine technology — Shipboard data servers to share field data at sea

- (5) ISO/DIS 23807 Ships and marine technology — General requirements for the asynchronous time-insensitive ship-shore data transmission
- (6) ISO/TS 23860 Ships and marine technology — Vocabulary related to autonomous ship systems
- (7) ISO/CD 4891 Ships and marine technology — Interoperability of smart applications for ship
- (8) ISO23323: 2021 Ships and marine technology — Specification for software-based planned maintenance systems
- (9) ISO21745:2019 Ships and marine technology — Electronic record books for ships — Technical specifications and operational requirements
- (10) ISO24060:2021 Ships and marine technology — Ship software logging system for operational technology
- (11) ISO, <https://committee.iso.org/home/tc8>
- (12) G. Tasse, Standardization in technology based markets, Res. Policy 27 (2000) 273–284.
- (13) Yanqing Li (TC8 Chair), Smart Ship Standardization seminar, ISO/TC 8 Progress in Standardization of Smart Shipping