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MARITIME AUTONOMOUS SURFACE SHIPS AS A NEW CHALLENGE FOR THE DEVELOPMENT OF INTERNATIONAL MARITIME LAW

Abstract. *The article is devoted to the study of Maritime Autonomous Surface Ships (MASS) as a new challenge for the development of international maritime law in the context of digitalization and the implementation of artificial intelligence technologies. The prerequisites for the emergence and active implementation of MASS in the field of international maritime transport, as well as their potential economic and operational advantages, are analyzed. It is established that the automation of shipping is accompanied by significant transformations of traditional legal approaches, particularly regarding the role of the crew, maritime safety requirements, and vessel management functions. Special attention is paid to the activities of the International Maritime Organization (IMO) in the development of a regulatory framework for MASS, including the Regulatory Scoping Exercise and the development of the MASS Code. The classification of levels of vessel autonomy and their impact on the formation of the legal regime of operation is examined.*

Key legal challenges in the regulation of autonomous shipping are identified, including the uncertainty of the legal status of the crew and the remote operator, the absence of clear rules on liability for the actions of autonomous systems, and the need to adapt international conventions to new realities. Attention is also given to cybersecurity issues, as autonomous vessels become complex cyber-physical systems vulnerable to cyber threats.

It is substantiated that the implementation of autonomous shipping requires a comprehensive revision of international legal norms, the development of new approaches to the allocation of liability among operational actors, and the creation of a unified international regulatory regime. It is concluded that harmonization at the global level is necessary to ensure maritime safety, environmental protection, and the efficient functioning of international maritime transport.

Keywords: *maritime law, shipping, International Maritime Organization, convention, liability, shipowner, legal regulation, international standards.*

Relevance of study. According to general trends, one of the most promising areas for the application of artificial intelligence in the near future will be its widespread use in national and international unmanned transport systems. The rapid development of digital technologies, artificial intelligence, and automated control systems has led to significant transformations in the maritime sector. One of the most innovative aspects of these changes is the emergence and gradual implementation of Maritime Autonomous Surface Ships in commercial shipping, capable of navigation and operation without direct crew involvement or with minimal human intervention.

The use of autonomous vessels can bring significant economic benefits, for example by reducing labor costs, as such vessels do not require living quarters, workplaces, or common areas for crew members. As a result, their design and construction may be considerably less expensive, along with other operational advantages.

At the same time, despite their potential, the practical implementation of autonomous maritime transport faces several challenges, which are not limited to technical or financial issues. Equally important is the question of whether the existing legal framework is capable of adequately regulating relations involving artificial intelligence as a “digital captain,” and whether autonomous vessels comply with the requirements of modern international maritime law.

Additionally, further analysis is required regarding the mechanisms for the distribution of liability among the shipowner, the operator of autonomous systems, and software developers, as well as the prospects for modernizing international legal norms considering the development of autonomous shipping.

Main Body. One of the key regulatory bodies in international maritime governance, the International Maritime Organization (IMO), has initiated the study of safety and environmental issues related to Maritime Autonomous Surface Ships (MASS), as well as the development of rules for their safe operation. As rightly noted by Veremchuk V.S., the IMO’s interest in developing a legal framework for autonomous vessels is driven by its intention to integrate advanced technologies into its regulatory system while balancing the benefits of innovation with safety, environmental protection, and trade facilitation concerns. [1]

In light of the technological novelty and the numerous legal uncertainties surrounding the regulation of Maritime Autonomous Surface Ships (MASS), the International Maritime Organization (IMO) initiated a Regulatory Scoping Exercise (RSE) in 2017, which was actively carried out by 2021. The purpose of this exercise was to determine how existing IMO regulatory instruments could address the safe operation of maritime autonomous surface ships with different levels of automation [2].

Maritime Autonomous Surface Ships (MASS) is a concept developed by the International Maritime Organization (IMO) to describe commercial vessels that operate with minimal or no human involvement. Their operation relies on software, sensors, and communication systems used for navigation, collision avoidance, and the performance of essential ship functions. [3].

According to the IMO, a Maritime Autonomous Surface Ship refers to a vessel that, to a certain extent, is capable of operating independently of human interaction. Such vessels represent a significant advancement in maritime transport and have the potential to fundamentally transform the shipping industry in several respects. In order to better understand and develop an appropriate regulatory framework, the IMO has not only provided a definition of MASS but has also introduced a classification system based on different degrees of autonomy, ranging from Degree 1 to Degree 4, where a higher degree corresponds to a greater level of automation. Degree 1: refers to a ship with automated processes and decision-support systems, where the crew remains on board to operate and control the ship’s systems and functions. Certain operations may be carried out automatically and, at times, without direct supervision; however, the crew is present and ready to take control at any moment. Degree 2: describes a remotely controlled ship with crew on board. The vessel is operated from a remote location (a shore-based control centre), while the crew remains on board to assume control and directly operate ship systems if necessary. Degree 3: refers to a remotely controlled ship without crew on board. In this case, the vessel is fully controlled and operated from a remote location, and no crew is present on board. Degree 4: represents a fully autonomous ship, where the ship’s control system can make decisions and determine actions independently, without human intervention. [4].

The use of Maritime Autonomous Surface Ships in international maritime transport gives rise to a few specific legal challenges. Accordingly, the introduction of such vessels necessitates both the

revision of existing international standards and the development of new ones to regulate the lawful use of technologies that replace human presence on board.

Among the key issues are concerns related to maritime safety in the context of autonomous navigation; the unresolved legal status of the crew of MASS; the need to amend the International Regulations for Preventing Collisions at Sea (COLREGs); the absence of clear rules governing cargo operations; and the allocation of liability for actions arising from the use of autonomous vessels.

For example, Rule 5 of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs) provides that “every vessel shall at all times maintain a proper lookout by sight and hearing... as well as by all available means appropriate in the prevailing circumstances and conditions, so as to make a full appraisal of the situation and of the risk of collision.” This wording is clearly human-oriented; however, it may be interpreted more broadly as referring to situational awareness on the part of whoever is responsible for the operation of the vessel, as well as their ability to make informed decisions in order to avoid collisions and other incidents. At the same time, there remains a need for greater clarity as to how this function is to be fulfilled in the absence of human presence on board. Moreover, the allocation of responsibility for maintaining a proper lookout becomes less evident when there are no human operators physically present to monitor the navigation of the vessel.

The absence of a crew on board a Maritime Autonomous Surface Ship (MASS) may significantly complicate, or even render impossible, situations in which international maritime law requires the physical inspection of a vessel, verification of its documentation, submission of requests and receipt of authorization for refuge, as well as the performance of mooring or pilotage operations within the waters of another state. It may also affect the ability to ensure compliance with obligations related to collision avoidance and the prevention of environmental pollution.

It is therefore evident that the resolution of these issues at the international level should be achieved through the adoption of new international legal instruments or, at a minimum, through amendments to existing norms of international maritime law. The current standards established by the STCW, COLREGs, and SOLAS Conventions have provided a solid foundation for maritime safety and vessel operation. However, the introduction of MASS requires careful reassessment and expansion of these frameworks in order to address the specific challenges and requirements associated with autonomy.

In 2021, the International Maritime Organization (IMO) conducted a regulatory review of Maritime Autonomous Surface Ships, within which existing IMO legal instruments were analyzed in terms of their applicability to vessels operating at different levels of automation. The IMO’s activities for the period 2024–2025 are focused on the development of the IMO MASS Code, a unified instrument intended to reflect contemporary practices in the operation of autonomous vessels, including issues related to remote control, operator qualifications, and navigational safety. The Joint Working Group of the Maritime Safety Committee, the Legal Committee, and the Facilitation Committee is expected to finalize the development of a non-mandatory Code by May 2026. Based on this instrument, the development of a mandatory MASS Code is planned to commence in 2028, which is expected to be incorporated as a new chapter of the International Convention for the Safety of Life at Sea (SOLAS), 1974. [5].

As part of the IMO’s work to ensure that the regulatory framework for Maritime Autonomous Surface Ships keeps pace with rapidly evolving technological developments, the Joint MSC-LEG-FAL Working Group on MASS (MASS-JWG) held its second session from 17 to 21 April 2023 at IMO Headquarters. This session was preceded by a workshop dedicated to the discussion of legal issues related to MASS. The Working Group was established to address key high-priority issues concerning safety, legal regulation, and facilitation, following the completion of the Regulatory Scoping Exercise aimed at assessing how existing IMO instruments apply to MASS and identifying regulatory gaps.

The Joint Working Group reached several important conclusions. It was agreed that a person (the master) must bear responsibility for a MASS, regardless of its operational mode or level of autonomy.

At the same time, the master does not necessarily have to be physically present on board, as this depends on the technologies used. Irrespective of the level of autonomy, the shipowner must retain the ability to intervene when necessary. It was also recognized that, under certain conditions, one master may be responsible for multiple MASS simultaneously.

In addition, the need to define key concepts was emphasized. In particular, a Remote Operation Centre was described as a location, separate from the vessel, from which some or all aspects of MASS functions may be controlled. A remote operator was defined as a qualified individual employed or engaged to control certain or all aspects of MASS functions from such a center. The specific requirements applicable to remote operators are to be further considered by the Maritime Safety Committee (MSC) in the course of developing the MASS Code. Furthermore, an updated work plan was agreed upon, subject to approval by the three committees [6].

According to the conclusions of the International Maritime Organization's working group, a key role is assigned to the MASS master, defined as the person bearing overall responsibility for the operation of a Maritime Autonomous Surface Ship, regardless of whether they are physically present on board the vessel or located within a remote operation center. In other words, in situations where no crew is present on board, the role of the master may be performed by an individual situated ashore. At the same time, as in traditional maritime practice, the shipowner formally appoints the master. At present, however, the concepts of both the remote operator and the MASS master remain insufficiently defined. [7]. The autonomous nature of Maritime Autonomous Surface Ships does not imply the absence of liability for incidents arising from their operation. The fact that no physical person is directly controlling the vessel does not eliminate legal consequences, particularly in terms of responsibility and accountability under applicable legal regimes.

Ensuring cybersecurity, particularly in connection with the operation of Maritime Autonomous Surface Ships, represents another key challenge for contemporary international maritime law. The increasing level of automation and digitalization in shipping leads to the emergence of new vulnerabilities associated with the use of navigational, communication, and control systems, all of which may become targets of cyberattacks. Among the most likely risks to cyber resilience is the infection of interconnected computerized systems — integrated into a single information environment — by malicious software. Given the constantly evolving nature of cyber threats, it is impossible to guarantee absolute protection of a vessel against such risks. Nevertheless, the implementation of cybersecurity and cyber resilience measures, along with the continued development of regulatory and technical requirements in this area, can significantly reduce both the likelihood of cyber incidents and their potential consequences, thereby contributing to the maintenance of an adequate level of maritime safety. At the same time, the development of autonomous shipping, including the implementation of cybersecurity measures in accordance with the International Maritime Organization's Resolution MSC.428(98) on Maritime Cyber Risk Management in Safety Management Systems, expands the scope of responsibility of the remote operator, as they directly interact with the vessel's digital control systems. However, it should be noted that autonomous vessels are not explicitly addressed in this instrument. Delays in developing and adopting the appropriate regulatory framework could render autonomous vessels highly vulnerable to hacker attacks during the initial stages of their practical deployment.

Conclusion. Undoubtedly, the emergence of autonomous vessels at all levels will necessitate a revision of the norms establishing requirements for the crew, including both its quantitative and qualitative composition. It will be necessary to develop appropriate systems for the training and certification of crew members of such vessels, as well as shore-based personnel capable of operating and maintaining autonomous ships.

In this regard, we agree with the position of O. Krasnikova, who argues that new maritime roles will emerge, such as an external (remote) master, shore-based crew members, and specialists in maritime security and cybersecurity. Furthermore, the scholar notes that the introduction of unmanned vessels will

lead to changes in the legal regulation of labor relations in shipping, as the need to ensure the daily living conditions of personnel on board will no longer be required [8].

The introduction of autonomous shipping into the maritime transport market is an objectively inevitable process, which necessitates the adaptation of existing international maritime law to modern technological realities. Current developments have placed before the International Maritime Organization a key task-bringing existing international legal norms and standards into line with the latest technological advancements in the field of autonomous shipping.

Further development of international maritime law should therefore be directed toward the establishment of unified approaches to determining the legal status of autonomous vessels, the allocation of liability among the entities involved in their operation and ensuring an adequate level of safety and protection of the marine environment.

Maritime Autonomous Surface Ships are transforming the classical paradigm of maritime law from an anthropocentric model to a technology-oriented one, in which the central element is no longer human behavior, but the functioning of complex cyber-physical systems.

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