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LEGAL CHALLENGES IN ENFORCING THE DUTY TO RENDER ASSISTANCE AT SEA: IMPLICATIONS FOR MARITIME AUTONOMOUS SURFACE SHIPS (MASS)

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Abstract: International Shipping is subject to both national and international regulations to ensure safe and sound shipping as well as to enforce rights and obligations. Technological advancement in the shipping industry especially the introduction of maritime autonomous surface ships (MASS) is going to bring a great change along with challenges. Moreover, there are issues concerning the regulation of MASS under existing regimes such as the meaning of the relevant terms, the requirement to have a master and crew on board, the master's duty to render assistance at sea, seaworthiness and avoidance of collisions. This paper aims to focus on the enforcement of the duty to render assistance at sea over MASS. Hence, this paper analyses the challenges that may arise while employing the duty over MASS, non-compliance under the present laws and the need for the adoption of a new regulatory framework to settle such non-compliances.

Keywords: Maritime Autonomous Surface Ships; Jurisdiction over Ships; State Jurisdiction over MASS; Manning of Ships; Unmanned Underwater Ships; Law of the Sea and Shipping.

1. Introduction

Regulating shipping under the purview of national and international regulations is open to challenges with the advent of technological advancements, particularly the introduction of maritime autonomous surface ships (MASS), the maritime industry is poised for significant changes and challenges (Kim et al., 2020). While MASS promises to enhance safety and environmental sustainability, uncertainties surrounding its various categories and specifications raise several concerns (Abudu & Bridgelall, 2024). Moreover, integrating MASS into the existing regulatory framework poses challenges related to terminology, crew requirements, the duty of

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a master to render assistance, seaworthiness, and collision avoidance (Kepesedi, 2022). These issues highlight potential jurisdictional conflicts under the law of the sea. To incorporate MASS within current shipping regulations, it is crucial to recognize and classify MASS as a ship within the international legal framework. The primary challenge lies in determining whether MASS qualifies as a ship given its unique automation feature. Despite these differences, various unconventional crafts have been accommodated as ships under international standards and legal interpretations. Similarly, certain MASS categories, based on their autonomy levels, could be identified as ships. According to the International Maritime Organization (IMO), MASS is defined as a ship that, to a varying degree, can operate independently of human interaction (Maritime Safety Committee, International Maritime Organization, 2018). Therefore, MASS is subject to existing regulations like other conventional ships and the application of such raises concerns and challenges.

Jurisdiction over MASS is primarily determined by the flag state's authority, a fundamental principle in shipping regulations. The United Nations Convention on the Law of the Sea (UNCLOS), 1982, is the starting point for understanding state jurisdiction over MASS. Besides various duties and obligations under UNCLOS, Article 98(1) specifically prescribes that flag states must require the master of a ship to fly their flag to assist persons in distress at sea. This obligation is also mandated by the International Convention for the Safety of Life at Sea (SOLAS). However, MASS may not have a traditional master due to its autonomous nature. While a MASS can relay assistance requests via radio, its capacity to provide physical aid without an onboard crew is questionable. However, the duty to render assistance is conditional, requiring the master to act only if it does not pose a danger to the ship, crew, or passengers, and if it is reasonable to do so (Article 98(1)(b) of UNCLOS). Some commentators argue that MASS, lacking human presence, might not be expected to fulfill this duty, beyond alerting manned vessels or search and rescue authorities (Munari, 2020; and Leopardi, 2022). The ability of MASS to meet the humanitarian obligation of rendering assistance at sea is highly dependent on the shore-based team's capacity to effectively coordinate with rescue services. This involves leveraging the vessel's advanced detection systems to monitor distress situations and communicate them to nearby manned vessels or search and rescue (SAR) authorities (McKie, 2023). While the MASS can serve as a platform for these operations, enabling the coordination of rescue efforts, its ability to physically intervene in rescue operations is limited without onboard human presence. Therefore, the shore-based control center plays a critical role in managing the vessel's participation in such scenarios, potentially guiding the use of the MASS as a relay or support mechanism in broader SAR operations.

The draft MASS Code (MSC 108/413, 2024) under discussion at the IMO further emphasizes that while autonomous ships must be integrated into the SAR system, their role will often be more about facilitating coordination than performing direct rescues (Maritime Safety Committee, International Maritime Organization [MSC, IMO], 2024). The shore-based teams, responsible for the remote operation of MASS, are expected to engage with SAR organizations, allowing for the use of the vessel's capabilities to assist in a rescue, even if physical rescue actions must be left to manned vessels or SAR units. Hence, this paper identifies the duty to render assistance at sea as a significant challenge for MASS, especially regarding the enforcement of flag state jurisdiction. Additionally, the role of the IMO as the "competent international organization" is critical in addressing these challenges and providing regulatory solutions for MASS. The research underscores the importance of IMO's involvement in developing a cohesive framework to manage the integration and operation of MASS within the global shipping industry.

2. Legal Framework for the Duty to Render Assistance at Sea

The duty to render assistance at sea is a fundamental principle of international law, designed to ensure the safety and protection of individuals in distress at sea (Papanicolopulu, 2016). This principle is articulated through several key legal instruments and conventions, which collectively form a comprehensive legal framework. UNCLOS explicitly mandates this duty in Article 98. This Article stipulates the obligation of the master of a ship flying the flag of a state party to UNCLOS to render assistance to any person found at sea in danger of being lost, provided that this can be done without serious danger to the ship, crew, or passengers (Attard, 2020). This duty includes rendering assistance to persons in distress and proceeding with all possible speed to the rescue of persons in distress if informed of their need for assistance, as long as it is reasonable to do so (Sar, 2023). Furthermore, UNCLOS emphasizes the responsibility of flag states to ensure that ships flying their flag comply with the duty to render assistance (Article 98 of UNCLOS), necessitating the enactment of appropriate laws and regulations and the implementation of administrative and technical measures (Article 98 of UNCLOS). The SOLAS regime further accentuates the obligation to render onboard assistance. SOLAS Annex Chapter V Regulation 33 deals with the duties of the master of a ship in distress. It stipulates that unless there are reasonable grounds for doing otherwise, the master of a ship in distress, shall with all speed, endeavor to afford assistance to persons in distress. Ships are required to inform the relevant rescue coordination center (RCC) of actions taken and of any instructions issued by the RCC (SOLAS Annex Chapter V Regulation 33). The RCC is to designate the ship or ships, best

equipped to render assistance, to arrange the co-ordination of the rescue operation, with a view to ensuring an effective use of resources. SOLAS also requires ships to maintain safety management systems (SMS) which include, inter-alia, procedures for all aspects of emergency response including rendering of assistance. Training of crew members in distress and equipment of ships to deal effectively with distress at sea is also prescribed under the SOLAS regime. Clearly, the obligation to render onboard assistance is an essential component of the SOLAS regime (Mutual, 2007).

The International Convention on Maritime Search and Rescue (SAR Convention) prescribes the duties of states in establishing and maintaining search and rescue regions (SRR) and related services. States are required to establish SRR and RCC which shall be responsible for the coordination of search and rescue operations to be carried out in the respective search and rescue region. Such measures shall be adopted as may be necessary to promote international cooperation and coordination between RCC with a view to ensuring effective and expeditious search and rescue operations in different areas. The SAR Convention spells out particular duties of states including, inter-alia, the obligation to undertake that assistance shall be rendered to any person in distress at sea who is unable to avail himself of the basic rights listed in the SAR Convention regardless of his nationality or status. States are also obligated to provide adequate training for search and rescue personnel while ensuring that adequate resources including ships and aircraft are available for SAR operations (Article 3 of the SAR Convention). It may be said that the SAR Convention elaborates some of the general obligations of states under the Convention for the carriage of goods by sea.

Besides, the IMO has a number of guidelines and recommendations which may be said to encourage the performance of the obligation to render assistance. Resolution MSC.167(78) deals with the humane treatment and safe disembarkation of the rescued persons and the Code of Safety for Special Purpose Ships (SPS Code) which contains requirements for the safety and operation of ships which are involved in SAR operations. Besides, national legislation and bilateral agreements also contribute to the effective enforcement of the obligation. Many States in order to ensure compliance by shipmasters and shipping companies have incorporated the obligation to render assistance into national maritime legislation (McKie, 2023). Bilateral agreements between states also enhance cooperation and coordination in search and rescue regions, especially in areas of high maritime traffic or difficult prevailing conditions.

The evolving landscape of MASS raises critical questions about the legal obligations to render assistance at sea, particularly in light of established case law. Cases such as the I'm Alone case ((Canada v. United States) (1935). 3 R.I.A.A. 1609) illustrate state liability in maritime actions and reinforce the broader obligations that vessels

have toward one another. Although this case does not directly relate to SAR operations, it sets a precedent for accountability in maritime law, an aspect that will become increasingly pertinent as MASS technologies are integrated into international shipping. As the legal framework adapts to accommodate the realities of autonomous vessels, the challenges of fulfilling the duty to render assistance will require significant legal interpretation and potential reform (Boviatsis & Vlachos, 2022). The integration of MASS into existing maritime laws will necessitate a thorough examination of liability, accountability, and the nature of human intervention in SAR operations, as these autonomous vessels will need to align with the humanitarian principles established by these landmark cases (Sar, 2023).

Furthermore, the obligation to render onboard assistance by autonomous ships demands additional mechanisms of enforcement and new technologies (Tsimplis, 2023). The question of whether autonomous systems have the necessary capabilities to effectively perceive distress and take appropriate measures also raises some technological and even ethical concerns (Tan et al., 2021; and Cappuccio et al., 2023). The duty to render assistance at sea is a well-established principle under international maritime law, with UNCLOS, SOLAS, and the SAR Convention forming the core legal framework. As maritime technology evolves, particularly with the advent of MASS, this framework will need to adapt to address the new challenges and ensure that the humanitarian obligation to assist those in distress at sea is upheld. The evolving dialogue around MASS and their duties will be critical for the ongoing discussions at the IMO regarding the development of the MASS Code, which seeks to clarify the operational and legal responsibilities of these vessels in the context of maritime safety and human life preservation.

3. The Emergence of Maritime Autonomous Surface Ships (MASS)

The emergence of MASS marks a transformative period in maritime history, bringing significant benefits and complex challenges. While MASS offer the potential for increased efficiency, safety, and sustainability, their ability to fulfill traditional maritime duties, such as the duty to render assistance, remains a critical concern. Adapting legal frameworks, enhancing technological capabilities, and fostering international collaboration are essential steps in ensuring that the humanitarian obligations of maritime operations are upheld in this new era. MASS is defined by the IMO as a ship that, to varying degrees, can operate independently of human interaction. The IMO categorizes MASS into four levels of autonomy: Degree 1 involves ships with automated processes and decision support systems while still having crew onboard; Degree 2 consists of remotely controlled ships with crew onboard; Degree 3 includes remotely controlled ships without any crew

onboard; and Degree 4 comprises fully autonomous ships capable of making decisions and performing operations without human intervention (Maritime Safety Committee [MSC], 2021).

The advancements in technology enabling MASS are complex, involving automation, artificial intelligence (AI), machine learning, and advanced navigation systems (Ghajour, 2024). These technological components collectively enhance the operational capabilities of MASS. Automation systems and AI algorithms enable MASS to perform complex navigational and operational tasks autonomously, processing vast amounts of data from sensors and other sources to make informed decisions in real time (Veitch & Alsos, 2022). Machine learning algorithms allow these ships to learn from historical data and improve their performance over time, crucial for handling the dynamic and often unpredictable maritime environment (Yang et al., 2024). Sophisticated navigation systems, including GPS, radar, and LiDAR, provide MASS with precise positioning and situational awareness, enabling safe and efficient navigation (Abidi et al., 2024). The benefits of MASS are substantial, including increased operational efficiency, reduced human error, and potential improvements in safety and environmental performance (Abudu & Bridgelall, 2024). Automated systems can optimize routes and speeds to minimize fuel consumption and emissions, contributing to more sustainable maritime operations (Raviv, 2024). Additionally, the reduction in crew-related costs and risks can lead to significant economic advantages.

Despite the promising advantages, MASS introduces several challenges in fulfilling the duty to render assistance at sea. These challenges span legal, technological, and ethical dimensions. The traditional legal definitions of "master" and "crew" are challenged by the presence of MASS, necessitating revisions to international maritime law to clarify responsibilities (Choi & Lee, 2021). There is also a need to ensure that flag states impose and enforce appropriate regulations on autonomous ships, aligning with international obligations (Stępień, 2022). The ability of autonomous systems to detect distress situations and make appropriate decisions is a significant concern. MASS must be equipped with reliable sensors and algorithms capable of recognizing and responding to emergencies (Chae et al., 2020). Furthermore, effective communication between autonomous ships, human-crewed vessels, and rescue coordination centers is essential for coordinated rescue efforts (Stępień, 2022).

The necessity of human oversight in critical situations raises questions about the reliance on autonomous systems for life-saving actions (Burgén & Bram, 2024). Ethical implications arise from deploying autonomous ships without fully resolving their ability to fulfill humanitarian duties, potentially compromising the safety and well-being of individuals in distress at sea (Ruhal, 2024). Addressing these

challenges requires a multifaceted approach. Updating legal definitions and frameworks to clearly delineate the responsibilities of autonomous ships is crucial (Ahmed et al., 2024). Implementing regulations that mandate a degree of human oversight, especially for higher levels of autonomy, can ensure that the duty to render assistance is upheld (Devitt, 2024). Investing in advanced AI and machine learning technologies can enhance the decision-making capabilities of autonomous systems (Devitt, 2024). Developing robust communication networks for seamless interaction between MASS and other vessels is also essential (Hwang & Joe, 2024). Establishing global standards and best practices for the operation of MASS in compliance with international maritime law is necessary (Kim et al., 2020). Conducting joint exercises and simulations involving MASS and traditional vessels can ensure readiness and interoperability in rescue operations (Yu et al., 2024).

The development of the non-mandatory Maritime Autonomous Surface Ships (MASS) Code, as part of the ongoing efforts by the IMO, introduces critical provisions that reshape how existing maritime obligations, including the duty to render assistance in chapter 10, paragraph 10.1.1, (MSC, 2024) may be enforced. These updates are crucial for adapting traditional maritime laws largely framed with human-operated vessels in mind to an era of automation. The draft MASS Code, expected to be finalized by May 2025, serves as a foundation to regulate the safe operation of autonomous ships alongside conventional vessels. Although non-mandatory at this stage, its framework will influence future legal obligations, particularly the duty to render assistance at sea, under SOLAS and UNCLOS provisions. Under UNCLOS Article 98, the master of a vessel is required to render assistance to anyone in distress at sea. However, this provision presupposes the physical presence of a master and crew. The challenge with autonomous ships is determining who assumes responsibility in the absence of an onboard crew. The MASS Code is poised to address this by defining new roles for "remote operators" or automated decision-making systems, (MSC, 2024), which could be held accountable for fulfilling this obligation. This, however, creates a legal grey area, as the concept of "master" and "crew" needs to be redefined in both legal and practical contexts.

4. Challenges in Enforcing the Duty to Render Assistance over MASS

The enforcement of the duty to render assistance at sea over MASS presents significant challenges that span legal, technological, and ethical dimensions. The traditional maritime framework, which relies heavily on human judgment and decision-making, is fundamentally challenged by the introduction of autonomous systems (Goerlandt, 2020). These challenges necessitate a revaluation of existing

laws, the development of new technologies, and a consideration of ethical implications to ensure that the duty to render assistance is effectively upheld in an era of increasing automation.

One of the main legal challenges is the ambiguity of the definitions of "master" and "crew" in the context of autonomous ships (Islam, 2024). Conventions such as UNCLOS and SOLAS were drafted with the assumption of human-crewed ships (Hasan, 2022). These conventions stipulate that the master of a ship has a duty to provide assistance to persons in distress at sea. However, in the case of MASS, where human presence may be minimal or non-existent, the question arises as to who bears responsibility for these obligations (Chen, 2024). The current legal framework does not clearly address the role and responsibilities of remote operators or autonomous systems, creating a legal vacuum that complicates enforcement efforts (Vojković & Milenković, 2019). Both UNCLOS and the salvage conventions limit the duty of the master to render assistance and state that assistance should only be rendered if it does not endanger the ship, passengers or crew. Similarly, the SOLAS Convention includes the limitation "capable of rendering assistance" (Annex 34, Resolution MSC.167(78)), which means an autonomous ship, even if positioned to help, cannot render assistance beyond alerting other ships or coastal authorities.

The MASS Code's Chapter on Safety and Navigation is expected to detail the specific technical and operational criteria necessary for MASS to comply with SOLAS provisions, including those related to distress signals and emergency response (MSC, 2024). The absence of a human crew raises the question of whether MASS can adequately detect and respond to distress signals (T. Kim & Schröder-Hinrichs, 2021). Given that autonomous systems rely on pre-programmed algorithms and sensor data, the legal responsibility to render assistance may shift toward the remote-control centers or even the ship's AI systems (Annex 34, Resolution MSC.167(78)). Thus, a significant revision of SOLAS Chapter V (Regulation 33), which mandates the master of a ship to provide assistance, will be necessary. This regulation must adapt to the context of autonomous vessels, clarifying whether remote operators bear the same legal burden as human captains. Moreover, enforcement mechanisms pose another challenge. Current international law relies heavily on flag states to ensure compliance. However, for MASS, particularly those operating across multiple jurisdictions, flag states may struggle to enforce compliance without clear definitions of responsibility. The IMO's ongoing efforts to define liability, both civil and criminal, for MASS-related incidents including failures to render assistance will likely require amendments to existing legal provisions, including UNCLOS Article 94 on the duties of flag states concerning the manning and safety of ships.

The UK Merchant Shipping Act requires the master to assist aircraft in distress unless this is considered unreasonable or unnecessary in the circumstances. Failure to do so may expose the master to criminal sanctions, but the Act does not address the shipowner's liability. This suggests that the absence of a master on an autonomous vessel could exempt it from this duty. Furthermore, the inability of autonomous vessels to carry people constitutes a "special circumstance" that makes it unreasonable for them to fulfill this duty. While the captain of a manned vessel is obliged to provide practicable assistance in the event of a collision, this is not possible for an autonomous vessel without life-saving equipment (Ringbom et al., 2020). Nevertheless, the autonomous vessel must alert nearby manned vessels or coastal states if it requires assistance. In practice, it is unrealistic to expect an autonomous vessel to provide assistance and physical help if there is no master on board who can be held accountable under the existing laws (Stevens, 2020). The complexity of the jurisdiction further complicates the prosecution of a captain for failure to assist, especially in cases involving asylum seekers or refugees (Patanè et al., 2020).

Section 364 of the Bangladesh Merchant Shipping Ordinance, 1983, mandates the master of a ship to render assistance upon receiving a distress signal, presenting significant challenges when applied to MASS. Autonomous ships lack a human master to interpret distress signals and make real-time decisions, necessitating advanced AI capable of identifying and assessing distress situations (Issa et al., 2022). Compliance with requisitions from distressed vessels and the need for clear criteria to release from obligations further complicate the integration of MASS. These ships must have standardized communication protocols and decision-making frameworks. Additionally, MASS require automated logging systems to meet documentation requirements, and the legal framework must address accountability, assigning responsibility to ship owners, AI developers, or remote operators (MSC, 2021). To effectively integrate MASS into this regulatory environment, technological advancements in AI, regulatory updates to include autonomous systems, and clear operational protocols are essential.

SOLAS Regulation III/17-1, which came into force on July 1, 2014, stipulates that all ships, including autonomous ones, must have plans and procedures for rescuing people from the sea. This regulation aims to ensure that every ship can act as a rescue resource, emphasizing the need for specific rescue capabilities. The International Chamber of Shipping (ICS) has issued guidelines to help companies comply with this regulation. It suggests that unmanned ships should be equipped and prepared for rescue operations. In order for autonomous ships to comply with SOLAS regulation III/17-1, they must be equipped with appropriate plans and equipment. Although

these vessels may not achieve the efficiency of manned vessels in rescue operations, they can still play a role if they are properly prepared. So, despite the practical challenges, unmanned vessels can meet the safety requirements of this regulation, provided they are properly equipped, and their systems are designed to facilitate rescue operations. Following these steps will ensure that autonomous ships can meet safety standards, even if their efficiency compared to manned ships is not yet proven. While autonomous ships present particular challenges in meeting the duty to assist, legal frameworks such as SOLAS provide a pathway to compliance. The integration of appropriate rescue equipment and procedures can enable these vessels to meet legal and safety obligations, albeit with some limitations compared to traditional manned vessels. The following table highlights the key legal instruments relevant to the duty to render assistance and challenges concerning the enforcement of such instruments in cases of MASS.

Table 1 Key Legal Instruments Relevant to the Duty to Render Assistance and MASS

Legal Instrument	**Relevant Provisions**	**Application to MASS**	**Challenges**
UNCLOS	Article 98 – Duty to Render Assistance	Requires ships to assist persons in distress at sea	Defining who fulfills the obligation on MASS (remote operators or AI system)
SOLAS	Chapter V, Regulation 33 – Obligation to assist ships or persons in distress	Applicable to "masters" of ships, traditionally human-operated	Unclear how autonomous vessels with no onboard crew can meet this obligation
SAR	Article 2 – Cooperation between parties to provide search and rescue services	MASS must participate in search and rescue (SAR) operations	Lack of legal framework for autonomous participation in SAR
IMO MASS Code (Draft)	Proposed framework for the safe operation of autonomous vessels	Clarifies technical and operational standards for MASS	No mandatory enforcement until 2030; lacks provisions for full autonomy
IMO Cybersecurity Guidelines	Revised guidelines on cyber risk management	Protects against cyberattacks, which could impair MASS response abilities	Ensuring MASS systems are cyber-resilient to respond to emergencies

Source: Own processing based on the analysis in this paper.

Enforcing the duty to render assistance at sea presents significant challenges, especially with the advent of MASS. Traditionally, the obligation falls on the ship's master, who must respond to distress signals, but autonomous ships lack a human captain to make such decisions. This complicates legal accountability and compliance, as seen in cases like the MV Tampa Incident (Ruddock v Vadarlis (2001) 110 FCR 491 ('Tampa case')), where a Norwegian cargo ship captain faced threats of prosecution for people smuggling after rescuing 433 asylum seekers. In this case, the Norwegian freighter MV Tampa rescued 433 asylum seekers in distress off the coast of Australia. Australia's refusal to allow the ship to disembark the rescued persons highlighted tensions between the duty to render assistance and state sovereignty. Although the incident involved a manned ship, the principles derived from the case are applicable to autonomous vessels. Specifically, MASS may face similar dilemmas where an unmanned vessel may be required to assist persons in distress, but political or operational challenges could complicate the fulfillment of that duty (Ulfbeck & Arda, 2023). This case emphasizes the need for clear international regulations concerning MASS, especially in complex SAR situations that involve state interactions. The jurisdictional complexities, where charges can be brought by the flag state, the captain's home state, or the victim's home state, further complicate enforcement (Klein et al., 2020).

5. Conclusions

The obligation to save those in distress at sea is one of the oldest obligations in the international maritime code, grounded in humanitarian as well as seafaring solidarity. This obligation, as codified in treaties such as UNCLOS, SOLAS, and the SAR Convention, is aimed at saving lives and rescuing persons in distress at sea. The use of MASS, however, fundamentally questions the ability to ensure that this duty to enforce itself will continue to be carried out, and will require new legal, technological, and ethical paradigms to be constructed. MASS, with its varying degrees of autonomy, offers significant benefits in terms of efficiency, safety, and environmental sustainability. These ships leverage advanced technologies such as artificial intelligence, machine learning, and sophisticated navigation systems to perform operations that were traditionally handled by human crews. While these advancements herald a new era in maritime operations, they also disrupt established norms and responsibilities, particularly the duty to render assistance.

The legal challenges are particularly pressing, as the current framework relies on human-centric definitions and responsibilities that do not easily translate to autonomous systems. Revising international maritime law to incorporate the roles and duties of autonomous ships and their operators is essential. Clear regulations and

guidelines are needed to ensure that MASS can fulfill the duty to render assistance, whether through remote operators or advanced autonomous capabilities. Currently, the ability to see and respond to a distress situation is mostly undeveloped for MASS. Emergencies require that the autonomous systems are well-provisioned with sensors, perfect AI algorithm specifiers and comprehensive secure communication network diagnosis to act effectively. The capabilities of these systems must continue to evolve through technology investment and testing under real-world conditions in simulation or elbow-to-elbow exercises. Ethically, the reliance on autonomous systems for life-saving duties raises significant concerns. The importance of human judgment and oversight in critical situations cannot be understated. Ethical guidelines must ensure that the deployment of MASS does not compromise the safety and well-being of individuals in distress. Human oversight, particularly in higher levels of autonomy, should be maintained to ensure that the humanitarian obligations of maritime operations are upheld.

The IMO envisions that by 2030, a mandatory MASS Code will be in force, which could include a new chapter in SOLAS or amendments to existing chapters. This mandatory code will likely address the operational capabilities of autonomous ships to detect, evaluate, and respond to distress situations, ensuring that MASS is equipped with the necessary systems to uphold their duty to render assistance. This could also require the inclusion of remote monitoring centers as a recognized element in international maritime law, with specific regulations detailing their duties and legal liabilities. The development of the MASS Code highlights significant gaps in the enforcement of the duty to render assistance, necessitating legal and technological reforms. As the non-mandatory code evolves into a mandatory framework, the redefinition of traditional maritime roles and responsibilities—such as those outlined in UNCLOS and SOLAS—will be essential to ensure that autonomous ships uphold the longstanding humanitarian obligations at sea. The IMO's phased approach provides a pathway for addressing these issues, but much work remains to be done to fully integrate autonomous technologies into the legal fabric of international maritime law.

In conclusion, the integration of Maritime Autonomous Surface Ships into global fleets presents both opportunities and challenges. The potential benefits of MASS in terms of efficiency, safety, and sustainability are substantial. However, the enforcement of the duty to render assistance requires a concerted effort to update legal frameworks, enhance technological capabilities, and establish ethical guidelines. By addressing these challenges, the maritime community can ensure that the humanitarian principles that underpin maritime law are maintained, even as the industry embraces the advancements brought by autonomous technologies. Through careful regulation, technological innovation, and ethical consideration, MASS can

be integrated into the maritime landscape without compromising the critical duty to assist those in distress at sea.

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