**Legalizing Autonomous Ships**

Henrik Ringbom[[1]](#footnote-1)\*

# *Scandinavian Institute of Maritime Law, University of Oslo, Norway; and University of Turku, Finland*

# INTRODUCTION

The increasing automation of ships and the related calls for removal of crews represents not only a major intervention in how ships are operated, but also a challenge for maritime law and the international law of the sea. The existing rules on the operation of ships, including maritime safety, crewing, and collision avoidance etc., are based on the premise that ships are manned and that there is at all times a crew on board that is responsible for the ship’s operation at sea and will intervene whenever required.[[2]](#footnote-2)

The accommodation of autonomous and/or crewless ships into the existing maritime law environment accordingly covers many different levels and types of rules. Starting from the law of the sea and the 1982 United Nations Convention on the Law of the Sea (UNCLOS), several existing provisions do not fit easily with remotely operated and, even less so, autonomous ships that operate without human involvement. Other challenges are to be found in the significant body of international safety rules (including maritime security and environmental protection) for shipping through some 40 international conventions adopted by the International Maritime Organization (IMO). In addition, national and regional rules on maritime safety will need to be adjusted to the new type of ships, as well as sub-national regulation in the form of local requirements and port by-laws etc.

Out of these regulatory layers, the rules adopted by IMO bear a particular significance for the overall regulatory landscape. Legalizing autonomous ships in the key IMO conventions will make the other regulatory layers mentioned above follow suit. Conversely, failure to reflect the development in the IMO rules will make it difficult to find a legal basis for the operation of such ships internationally.

IMO has assumed its responsibility in this respect and has in the past few years invested significant resources in the challenges posed by Marine Autonomous Surface Ships (MASS). So far, the focus has been on understanding the magnitude of the problem, through a regulatory scoping exercise. Recently, however, IMO has also taken a first step towards authorizing trials with MASS, which could have some implications for the legal setting.

 The present article reviews the current international developments in a broader ocean policy context. Following a brief discussion on some key issues of terminology relating to autonomous ships in section 2, the main legal challenges in the existing IMO conventions are reviewed in section 3. The review illustrates that while direct conflicts with existing IMO rules are relatively few, several of the key safety conventions include requirements that can only serve to authorize MASS if understood and interpreted in a particular way. This, too, calls for some form of regulatory intervention at the international level. The main part of the article in section 4 addresses certain law of the sea issues linked to autonomous ships, depending on the capacity in which States act and on their policy approach towards autonomous ships. A particular focus is on navigational rights and the interrelationship between international rules, notably between UNCLOS and the IMO rules, when it comes to authorizing autonomous ships. Section 5 concludes that IMO’s engagement in the matter is crucial for enabling the existing regulatory framework to accommodate autonomous ships, but also proposes that the focus of IMO’s work at some point needs to shift from existing rules to the novel regulatory challenges posed by MASS, in order to provide a more useful contribution to the regulatory exercise ahead.

 In view of the focus on regulation needed for allowing MASS to operate at the international level, the focus of the article is on international safety, crewing and collision avoidance rules, leaving matters relating to liability and apportioning of blame in an automated context beyond its scope. Another caveat is that ‘manning’ in this article relates to the manning of the bridge of the ship.

# 2. ON TERMINOLOGY AND THE USE OF CONCEPTS

Since autonomous ships is a fairly new topic in regulatory discussions, it is only natural that the matter is surrounded by considerable conceptual uncertainty. For the purposes of its ongoing work in the regulatory scoping exercise, IMO has defined MASS as “a ship which, to a varying degree, can operate independently of human interaction.”[[3]](#footnote-3) The definition suggests, first, that it is the division of tasks between humans and technology that is in focus and, second, that it represents a sliding scale in which tasks may be attributed to technologies “to a varying degree.” To facilitate its work, the IMO’s working group on MASS has identified the following four ‘degrees of autonomy’:

1. *Ship with automated processes and decision support:*Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated.

2. *Remotely controlled ship with seafarers on board:*The ship is controlled and operated from another location, but seafarers are on board.

3. *Remotely controlled ship without seafarers on board:*The ship is controlled and operated from another location. There are no seafarers on board.

4. *Fully autonomous ship:*The operating system of the ship is able to make decisions and determine actions by itself.[[4]](#footnote-4)

Two of the four degrees of autonomy relate to remote-control, which is not, strictly speaking, related to autonomy, but rather to the location from which human functions are performed. Relocating crew from the ship to shore raises different legal issues from the replacement of crew functions by onboard technology and the two aspects should therefore be conceptually separated.

 Another problem with including both crew location and autonomy in IMO’s four degrees of autonomy is that that division leaves only two parameters for each aspect which, in turn, fails to appreciate their sliding scale. In addition to either being fully manned or completely unmanned, a ship might very well operate by means of a reduced crew and thus have an only periodically unmanned bridge. Similarly, rather than having to choose between mere “decision support” and “fully autonomous,” as defined by IMO above, it seems quite plausible that key navigation functions of MASS will only be partially performed autonomously. An example is where human intervention is available, but is only activated by alarms triggered by the system itself, e.g., where the pre-established navigational safety parameters (such as safe distances, traffic density, etc.) cannot be maintained.

 In order to capture such variations, a somewhat different conceptual framework is used here, separating the two main aspects of the development towards autonomous ships: onboard manning and level of autonomy. The separation highlights that the manning of a ship is not necessarily linked to the level of autonomy and *vice versa*. The two aspects raise different legal issues and both aspects may exist to varying degrees.[[5]](#footnote-5)

 As to onboard manning, the main legal obstacles are to be found in the rules that require crew members to be physically present on board ships. Different rules apply at different stages of crew reduction, but it seems, bluntly put, that it is the removal of the first and the last crew member from the bridge that gives rise to most legal complications. In particular, the rules of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention) Part VIII require physical presence by the watchkeeping officer on the bridge at all times.[[6]](#footnote-6) This obligation is unqualified and hence violated as soon as the officer leaves the bridge. At the other end, a series of existing rules require there to be persons performing different functions on board ships, such as the master or the ship security officer.[[7]](#footnote-7) These functions can at least in theory be met as long as one person remains on board the ship.

 Autonomy, by contrast, relates to the division of tasks and responsibilities between human beings and technology.[[8]](#footnote-8) The main legal challenge here is that certain rules require a human to be in the navigational decision-making loop. For example, the collision avoidance rules in the International Regulations for the Preventing of Collisions at Sea (COLREGs) presume a human presence by referring to the “good seamanship” of the individuals in charge of navigation and by specifying that navigational decisions are not supposed to deviate from the “ordinary practice of seamen.”[[9]](#footnote-9) Another example is the maritime liability regime, which is commonly based on the premise that a human being has been at fault somewhere in the chain of events leading to an incident.

 The autonomy level is not determined by the technical capabilities of the ship, but by the way in which it is operated. Between the two extremes of no autonomy (full human oversight and control) and full autonomy (no human involvement), two additional categories are needed to illustrate the key legal distinctions. The ‘monitored autonomy’ (human monitoring) refers to the case where independent systems operate the ship, but crew members continuously monitor the automated functions and are expected, and required, to intervene immediately if the system fails to perform as prescribed. In this variant, the autonomous system offers decision support for the crew, but involves no alteration of their role or responsibilities. By contrast, in the ‘constrained autonomy’ option (human availability), the automated system operates the ship independently and without human supervision, but the crew must be available to assume control when the system requests assistance. In the ‘fully autonomous’ mode of operation, the system operates entirely without human involvement and crew members are not required to be available.

 For legal purposes, the critical issue is control over navigational decisions, rather than the level of sophistication of the system. The main distinction lies in the area where the ‘monitored autonomy’ moves into ‘constrained autonomy’. It is at this point that the system is authorized to act on its own, without human supervision, and its role shifts from offering assistance to being in charge. The technical capabilities of the system and the percentage of time that it operates autonomously matter less in this respect.

 ‘Full’ autonomy, too, exists at different levels of technical sophistication. While less advanced autonomous systems make their navigational decisions based on fairly simple algorithms and pre-programmed software, more advanced autonomous operation systems may be self-learning in the sense that they develop their decision making on the basis of experience. For present purposes, however, those distinctions are not relevant as the key question here is whether autonomous systems may be authorized to be in charge of the navigation of ships at all. Figure 1 is an effort to highlight the distinction between the manning level and the level of autonomy, including the gliding scale that features in both aspects and also to illustrate that some amount of regulatory intervention arises at a relatively early phase of development on both axes.

[INSERT Figure 1]

The onboard manning level of a ship will normally not change frequently and a particular ship will, therefore, generally have a fairly stable manning level. By contrast, the level of autonomy refers to the actual operation of the ship rather than its capacity to operate autonomously. The level may change repeatedly during a single voyage, as it may depend on the sailing area, traffic conditions, and other parameters. In order to establish the autonomy level it is thus also relevant how decisions on the autonomy level are made, i.e., whether it is the system itself that decides on the level or if that decision is made by humans.

 A solid regulatory framework for autonomous shipping operations should be able to deal with all these variations and should not be limited to a specified level of manning or autonomy. As has been shown above, legal issues related to MASS do not arise only once the ship is fully autonomous or entirely unmanned. Even a partially unmanned ship, as well as a ship that is acting autonomously for only part of the time, needs a new regulatory framework as they will be confronted with many of the same legal issues that apply to fully unmanned and/or autonomous ships.

# 3. IMO RULES

##

## Existing Rules

Even before the IMO’s regulatory scoping exercise is concluded, it is possible to make some assessment regarding the scale and nature of the challenge that MASS poses for existing rules, at least in broad terms.[[10]](#footnote-10) Generally speaking, the IMO requirements are laid down in terms of functions that shall be performed and are usually neutral as to the method by which that is achieved.

 Relatively few of the existing rules therefore positively prohibit autonomous or unmanned ships.[[11]](#footnote-11) One of the few examples of a direct conflict are the watchkeeping provisions of the STCW Convention mentioned above.[[12]](#footnote-12) It is simply not possible to comply with the requirements of physical presence on the bridge at all times, if the functions of the watchkeeping officer are performed remotely, or replaced by technology.

 The more typical scenario is that the IMO rules do not directly conflict with autonomous ships, but need to be understood or interpreted in a particular way in order to permit autonomous or unmanned operations. Such interpretations involve all parties to the conventions in question and cannot therefore be done separately by individual parties (flag States) to them. The conventions that give rise to most legal questions, and which will therefore be in focus here, are SOLAS, COLREGs, and the STCW Convention.

 The main international maritime safety convention, SOLAS, provides considerable flexibility for flag States when it comes to technical standards. It provides a broad discretion for flag States to approve equivalent solutions and exemptions to the requirements in Chapters II-IV, provided the flag State is satisfied that the safety level is not compromised. The more operationally oriented requirements relating to safety of navigation in Chapter V are not as flexible, but even here the focus on functions and the chapter is mostly neutral when it comes to technical solutions. Even the crucial Regulation V/14, dealing with the safe manning of ships, only provides that all ships “shall be sufficiently and efficiently manned.” The means of achieving that is not by providing a certain minimum number of crew, but by listing in the associated guidelines on safe manning a series of functions that need to be performed by the ship’s crew.[[13]](#footnote-13) The guidelines are generally formulated by means of goals to be achieved, which opens the door for both remote and autonomous operations. Indeed, the guidelines specifically provide that the technical equipment and level of automation are to be taken into consideration when deciding on manning levels.[[14]](#footnote-14) Strictly speaking, neither Regulation V/14 itself, nor the guidelines to which it refers, rule out that a flag State determines that the safe manning level for a particular MASS can be set at zero, but a clarification of this matter would certainly seem desirable before flag States start issuing such manning certificates.

 A related key issue that would require some legal confirmation, at least in the form of a uniform interpretation, is whether the functions required by the IMO rules can be performed from a different location than on board the ship itself. Can, for example, the master of a ship be located on shore? If so, can the master be in charge of several ships at the same time? Such questions are horizontal in the sense that they apply to many different IMO conventions and their clarification would accordingly resolve a large number of the identified legal challenges.

 A review of the main IMO conventions also reveals that questions regarding the meaning or utility of several rules will be raised, in particular if there are no crew members on board the ship. Examples include access or evacuation requirements, rules on accommodation spaces, and crew drills, etc. All these rules require some form of common understanding on how they are to be understood and applied in the absence of any crew members on board.

## New Rules

Reviewing the legal hurdles only in relation to existing IMO rules is insufficient for providing a full picture of the nature of the regulatory challenge posed by the introduction of MASS. The most difficult aspects of the challenge relate to *new* features, which have not been regulated before. MASS represents a new development and involves many issues that IMO has never had to regulate before. The point is illustrated by the following three examples of categories of issues for which new rules would be needed to ensure some basic safety standards for MASS.

 A first category relates to the gathering of situational awareness information by technological means. Independent of whether the development will be towards remotely operated ships or autonomous ships, the current lookout requirements, which are based on human functions, notably ‘sight and hearing’,[[15]](#footnote-15) need to be adjusted to new forms of technology on board, such as cameras, various forms of radars, acoustic sensors, etc. While there are some precedents in this field,[[16]](#footnote-16) IMO has not yet had to deal with a situation in which the *entire* lookout function is delivered (and processed) electronically. This future prospect raises new questions on, *inter alia*, the performance requirements for the sensors and the data processing equipment, the independence and hierarchy between different technologies employed, the principles governing the integration of data, redundancy requirements, and monitoring and oversight tools.

 A second category of issues concerns the relocation of functions from the ship/bridge to a remote location. Remote control is not, strictly speaking, about autonomy, but is in practice closely linked to the development of MASS. Apart from resolving the issues linked to physical presence on the bridge, remote operation requires certain minimum technical standards on the communication between ship and shore, including requirements on communication technology, data transmission capacity and speed, and cyber-security. Moreover, since delays or breakdowns in data transmission are perfectly foreseeable, remotely operated ships with no crew on board also need to have arrangements with respect to their (autonomous) back-up functions to operate, or at least survive, until communication is restored.

 Third, the most significant aspect of the shift towards autonomy as a matter of principle is the acceptance that technology may replace human operational decision making. If pre-programed software and algorithms are to be accepted as alternatives to crew-based decision making, and allowed to be in charge of the operation of the ship, even if only in short periods, some standards will be needed for the conditions for operating such systems, acceptable safety margins, and the standards of the underlying ‘intelligence’ software. Possibly, automated decision making will even give rise to a need to regulate the distribution of responsibility between the persons involved in their development, integration and application, as this group extends well beyond persons traditionally associated with the operation of ships.

 All three examples relate to completely new regulatory challenges for the IMO, which can hardly be left unregulated at the international level if MASS are to be introduced in a safe and harmonized fashion. It may very well be that new rules on these matters should be more flexible and goal-oriented than current prescriptive requirements for ships.[[17]](#footnote-17) Yet, even goal-based standards need some careful regulation as to the goals to be achieved and the more detailed functional requirements and criteria required for achieving those goals. That regulatory challenge will not be resolved or even understood by only analyzing existing conventions, but will need rules to be developed from scratch.

 Based on somewhat comparable experiences at IMO in the past, it seems that matters affecting the role of the crew tend to be difficult and controversial. The best, and perhaps only, relevant precedent to date is the regulation of periodically unattended machinery spaces permitting engine rooms to be unattended for parts of the time provided certain criteria are met. These rules were eventually inserted into SOLAS following some 20 years of preparation.[[18]](#footnote-18)

 However, a very first step has recently been taken towards permitting MASS to operate in international waters, through the adoption in June 2019 of Interim Guidelines for MASS trials.[[19]](#footnote-19) Even if in the form of interim guidelines only, this instrument could nevertheless represent the first step towards authorizing MASS to operate internationally on a trial basis. The interim guidelines are discussed in more detail in section 4.

# 4. LAW OF THE SEA CONSIDERATIONS

##

## General

UNCLOS is an authoritative and widely accepted ‘constitutional’ convention, addressing the rights and obligations of States with respect to all uses of the sea.[[20]](#footnote-20) It is a framework convention, designed to last for decades. Therefore it does not lay down precise substantive standards relating to the operation of ships, but provides the general regulatory framework for the prescription and enforcement of such standards. With respect to shipping, a characteristic feature is the ambition to establish a uniform set of minimum rules for shipping that apply worldwide, irrespectively of flag and trading area. Elements in this respect include the emphasis of a competent international organization (in the singular) and frequent references to “generally accepted international rules and standards,” the jurisdictional effect of which extend to States that have not formally accepted those rules.[[21]](#footnote-21)

 There is no reason to assume that autonomous or unmanned cargo ships will not be considered to be ‘ships’ or ‘vessels’ within the meaning of UNCLOS.[[22]](#footnote-22) The Convention’s detailed rules with respect to States’ rights and obligations in their capacity as flag, coastal and port States can therefore be expected to apply to such ships as well.

 In this article, three different issues relating to UNCLOS and autonomous ships will be addressed. The relationship between UNCLOS and IMO when it comes to new regulations is explored, the main question being whether UNCLOS, as has been suggested, contains limitations for the IMO on the development of a legal framework for MASS.[[23]](#footnote-23) The rest of the article deals with the scenario in which IMO has *not* adopted specific rules to authorize the operation of MASS. The discussion below deals with States’ opportunities under international law to *authorize* and implement autonomous ships in the absence of IMO rules on this topic. The matter is discussed separately from the perspectives of flag States, coastal States and regional or bilateral arrangements. The jurisdictional significance of the IMO’s recent Interim Guidelines on MASS trials in this respect is discussed, while the final subsection addresses the extent to which States or regions may lawfully *deny* the operation of MASS in their coastal waters.

## UNCLOS, IMO and the Manning of Ships

The main responsibility for ensuring the safety and environmental performance of ships, irrespective of the sea area concerned, lies with the ship’s flag State. Autonomous shipping operations could raise particular compatibility issues with UNCLOS Article 94, which obliges every flag State to “effectively exercise its jurisdiction and control in administrative, technical and social matters over ships flying its flag.”[[24]](#footnote-24) This includes taking measures necessary to ensure “the manning of ships” and “that each ship is in the charge of a master and officers who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship.”[[25]](#footnote-25) The wording could be seen as preventing the introduction of fully autonomous ships,[[26]](#footnote-26) but has less impact on remotely operated ships and, even less so, on periodically unmanned ships.

 However, UNCLOS does not prevent the introduction of new technologies. On the contrary, it carefully avoids ‘freezing’ the flag State requirements at a given point in time, or at a given technical level, by referring to each flag State’s obligation, in taking the measures called for in Article 94, “to conform to generally accepted international regulations, procedures and practices and to take any steps which may be necessary to secure their observance.”[[27]](#footnote-27) In this way, UNCLOS links the obligation of flag States to prescribe relevant substantive, technical standards to the continuously changing set of international rules to be developed elsewhere (notably at the IMO) and hence allows technical development to take place while still preserving the international character of the rules in question.[[28]](#footnote-28)

 It is therefore submitted that the IMO can regulate matters related to autonomous ships, even if it gives rise to some tension with the wording of paragraph 4 of UNCLOS Article 94. The wording of UNCLOS, as a framework convention with ‘constitutional’ objectives, should not be construed as preventing the introduction of new technologies for shipping, if the international maritime community so desires. However, at least with respect to entirely crewless ships, legality under Article 94 presupposes that the matter is subject to more detailed global regulation, or is at least specifically endorsed, by the IMO.

## National or Regional Authorization of MASS

###

### *The Flag State Perspective*

For flag States, MASS operations involve two different issues. On the one hand, flag States need to identify the requirements and standards that ships have to meet in order to be authorized to operate. Standards and minimum requirements have to be developed for new issues such as remote control or electronic lookout. This is not different from any other specific ship category that is subject to special rules. From a jurisdictional point of view it is uncontroversial that flag States can exceed the IMO (minimum) requirements for specific ship types, e.g., by requiring additional or more stringent safety equipment on board. In the absence of international rules on a minimum number of crew members, flag States could also authorize the replacement of crew members with technology, provided it is satisfied that the solution is as safe as traditionally operated ships.[[29]](#footnote-29)

 On the other hand, the development of MASS standards at least implicitly involves an authorization for such ships to depart from existing international requirements. As noted above, there are many international requirements that either cannot be complied with or need to be understood or interpreted in a certain way to be compatible with the operation of MASS.[[30]](#footnote-30) In addition, a series of other issues relating to the interaction of ships at sea may have to be understood in a very particular manner to accommodate MASS operations, e.g., regarding the modalities of respecting the duty to render assistance to persons in distress under UNCLOS Article 98 and SOLAS Regulation V/33.

 Most flag States are bound by those standards, both through UNCLOS Articles 94 and 211(1) and through the IMO conventions concerned.[[31]](#footnote-31) They cannot easily, unilaterally or within a group of States, decide to disregard the terms of the conventions without the approval of the other parties.[[32]](#footnote-32) In conclusion, therefore, it is not the additional rules, but the failure to comply with some of the key existing international safety rules, such as STCW Regulation VIII/2 or COLREGs Rules 2, 5 and 8 that presents the principal legal obstacle for flag States to approve MASS in international traffic.

### *The Coastal State Perspective*

However, while the above represents the starting point for ships navigating in international waters, it also needs to be assessed to what extent a (coastal) State may provide exceptions by permitting the operation of MASS (by any flag State that has approved them, including the coastal State itself) for ships trading exclusively within its own maritime zones. In the absence of international legal support for MASS, the extent to which coastal States may permit such ships to navigate in their own maritime zones depends highly on the sea area concerned.

 Internal waters, including ports, form part of the sovereignty of the State (UNCLOS Article 2) and in the absence of specific limitations, the jurisdiction over foreign ships in this area is therefore complete. Moreover, ships have no general right to access foreign ports and port States’ wide discretion to impose conditions for entry on foreign ships is widely acknowledged, including in UNCLOS Articles 25(2), 211(3) and 255. In addition to the virtual absence of international navigational rights in internal waters, many of the international safety rules do not apply to ships that are exclusively trading in national waters or between national ports.[[33]](#footnote-33)

 On this basis, a coastal State may both permit the operation of (domestic and foreign) MASS in their internal waters and require other ships entering those waters to accept and respect the presence of MASS therein as a condition for entry. A prudent coastal State would have a self-interest to inform other ships in advance about the presence of MASS and of potential special rules or implications that apply in the areas concerned. If ships of other States were not prepared to accept the perceived risks involved with co-navigating with MASS, they could decide to stay out of such areas, but if they decided to enter they could not object to the presence of MASS in such waters.

 In the territorial sea, which can extend up to 12 nautical miles from the coastline or baseline, the situation is somewhat different. The territorial sea forms part of the territory of the coastal State and its sovereignty applies subject to explicit exceptions, one of which being that all foreign ships have a right of innocent passage through these waters. This suggests that coastal States are free to introduce their own national rules to govern the presence of (national and foreign) MASS in their territorial sea, e.g., by designating particular MASS testing areas, as long as the right of innocent passage of other ships is maintained. Under Article 24(1), coastal States specifically “shall not hamper the innocent passage of foreign ships through the territorial sea except in accordance with this Convention” and shall, in particular not “impose requirements ... which have the practical effect of denying or impairing the right of innocent passage” (Article 24(1)(a)).

 It is difficult to see how the presence of MASS in the territorial sea as such could be held to hamper the right of innocent passage of other ships. That right relates to the use of other States’ territorial sea for the sole purpose of navigating through these waters and is subject to a number of qualifications relating to the passage and the innocence thereof.[[34]](#footnote-34) The presence of MASS in the area would not have the practical effect to deny or impair foreign ships’ passage, in particular as locally authorized MASS operations would normally seek to promote the integration of MASS into an environment of traditionally operated ships. Even if certain MASS operations were considered to involve more risks for other ships, it may be noted that coastal States in such cases have a right to temporarily suspend foreign ships’ right of innocent passage “in specified areas of its territorial sea ... if such suspension is essential for the protection of its security.”[[35]](#footnote-35) Moreover, the right of innocent passage does not include a right to choose *any* route in other States’ territorial sea. Coastal States have specific powers to require foreign ships to use “such sea lanes and traffic separation schemes as it may designate or prescribe for the regulation of the passage of ships,” and “where necessary having regard to the safety of navigation.”[[36]](#footnote-36)

 Ships exercising their right of innocent passage must comply with coastal States’ laws and regulations on, *inter alia*, “the safety of navigation and the regulation of maritime traffic” and with “all generally accepted international regulations relating to the prevention of collisions at sea.”[[37]](#footnote-37) The latter quote suggests that any MASS operating in the territorial sea shall operate by the same collision avoidance rules as other ships. This also follows from the geographical scope of applicability of the COLREGs.[[38]](#footnote-38)

 Under UNCLOS Article 24(2) the coastal State shall “give appropriate publicity to any danger to navigation, of which it has knowledge, within its territorial sea,” which at least in the early phases of MASS probably must be understood as a duty to inform other ships of the presence of MASS in the area.

 In conclusion, international law of the sea supports the proposition that the operation of (national and foreign) MASS may be authorized by a coastal State in its territorial sea as part of its territorial sovereignty, as long as the right of innocent passage of other foreign ships is not “hampered” and subject to the requirements relating to notification, publicity and other precautionary requirements that are included in various parts of UNCLOS Part II, section 3.

 The same conclusion would appear to apply in the parts of the territorial sea that form part of ‘straits used for international navigation’, even if passage in such straits is subject to the regime of transit passage. Despite the more liberal navigational right awarded to ships in transit passage through such straits,[[39]](#footnote-39) for the purposes of MASS the distribution of rights and duties between ships and States bordering the strait is very similar to that governing innocent passage in the territorial sea. As long as the passage rights of foreign ships are not affected, the bordering State retains jurisdiction to regulate other aspects of navigation in these straits.[[40]](#footnote-40) The bordering State’s legislative jurisdiction specifically covers “the safety of navigation and the regulation of maritime traffic” and the adoption of sea lanes,[[41]](#footnote-41) and such requirements shall not “have the practical effect of denying, hampering or impairing the right of transit passage.” Specific duties apply for coastal States to publicize any known danger to navigation in the straits.[[42]](#footnote-42)

 Foreign ships exercising the right of transit passage, on their part, have an obligation to comply with the laws and regulations adopted by strait States in conformity with UNCLOS, and with generally accepted international maritime safety rules and standards, including specifically the COLREGs.[[43]](#footnote-43) They shall proceed without delay through such straits and shall “refrain from any activities other than those incident to their normal modes of continuous and expeditious transit unless rendered necessary by force majeure or by distress.”[[44]](#footnote-44)

 For present purposes, the main legal difference between innocent passage and transit passage is that the latter right may not be suspended, even temporarily, by the bordering State.[[45]](#footnote-45) More importantly, perhaps, the main difference in practice is likely to be that international straits, in view of their importance for international navigation, are likely to be subject to a lower threshold for what will be regarded as ‘hampering’ or ‘impairing’ the right of transit passage compared to the threshold relating to innocent passage in other areas of the territorial sea.

 By contrast, coastal States’ jurisdiction to have their own standards for permitting the operation of MASS does not reach out to the exclusive economic zone (EEZ). In the EEZ, which may reach up to 200 nautical miles from the baseline, the presumption is the opposite from that in the territorial sea. Freedom of navigation applies and is limited only to the extent that that coastal States have been granted jurisdiction over specified matters. The rights and jurisdiction provided to coastal States do not extend to maritime safety, insofar as it does not relate to the protection and preservation of the marine environment (Article 56(1)), while the flag State freedoms, including the freedom of navigation specifically apply (Article 58(2)). Flag States and coastal States must operate with due regard for the interests of each other in this zone (Articles 56(2) and 58(3)), but there is no provision to suggest powers for the coastal State to authorize MASS that do not comply with international safety standards to navigate in their EEZ.

 The regulation of MASS by coastal States on the high seas is obviously even more difficult. Here, a flag State’s jurisdiction over its ships is in principle exclusive “save in exceptional cases expressly provided for in international treaties and [UNCLOS]” (Article 92(1)). A number of exemptions to this main rule exist, but none of them is relevant for the question of navigational rights of unmanned or autonomous ships. In conclusion, as long as MASS do not comply with the international safety rules, flag and coastal States wishing to deploy them seem to be limited to operating them in their internal waters and territorial sea.

### *Bilateral or Regional Rules*

In the absence of regulatory progress at IMO to permit the global deployment of MASS, pressure increases in and from States that wish to take a leading role in this development. It has been proposed that bilateral or regional rules might be put in place to permit the early mover to go ahead while awaiting the global regulatory regime to catch up later.[[46]](#footnote-46)

 Indeed, regional solutions have sometimes been resorted to in the field of maritime safety and environmental protection to accelerate regulation at the global level. A prime example in this respect is the maritime safety policy of the European Union, which has challenged the IMO’s regulatory regime for decades by supplementing it by complementing, and sometimes even competing, rules for ships operating in the Union.[[47]](#footnote-47)

 Usually, unilateralist challenges in shipping appear in a form where a State or region requires ships entering their ports or, less commonly, coastal waters to comply with rules that go beyond the internationally accepted minimum rules. The unilateral rules typically build upon, but are more stringent than the international rules, and ships may avoid the regional rules by choosing not to trade in areas where the rules apply.

 In the context of MASS, the jurisdictional setting is different, for two main reasons. On the basis of the above review, it appears, first of all, that in promoting MASS it is mainly the *flag* State, rather than coastal and port States, that will be challenging the applicable international requirements. The jurisdictional role of coastal and port States is confined to allowing the use of MASS in their internal waters and, with certain limitations, in the territorial sea. Until such a time when port States start proclaiming that they will deny non-MASS the right to enter their ports, any real decisions with respect to advancing the technology on board ships will rest with flag States.[[48]](#footnote-48)

 Second, and more importantly, it was already noted that by authorizing MASS, flag States will not only exceed international standards (by extending requirements to matters that are not currently regulated at the international level), but will inevitably also fail to be in compliance with certain key international safety and manning rules and raise important issues of interpretation with respect to many more such rules. This raises the issue of compliance with UNCLOS Article 94 as well as issues of treaty law in relation to the flag State’s treaty partners to the IMO conventions. Under the latter, treaties can be modified by some of the parties only under strict conditions that are not usually met for IMO conventions.[[49]](#footnote-49)

 The flag State perspective also extends the geographical reach of the problem to being worldwide, rather than limited to ships trading in a given geographical area. Flag State responsibilities apply irrespective of the sea area concerned and a violation of international standards may at least in theory be raised by any State “which has clear grounds to believe that proper jurisdiction and control with respect to a ship have not been exercised.”[[50]](#footnote-50) It may even be argued that flag State violations represent *erga omnes* obligations that a State has towards the international community as a whole and in whose protection *all* States have a legal interest, as opposed to violations vis-à-vis other States.[[51]](#footnote-51)

 Arguing that flag and port States unilaterally could agree between them to operate MASS in international trade provided all ports are covered is not jurisdictionally different from arguing that the EU has the jurisdiction to allow EU-flagged MASS to operate between EU ports, or that a group of developing States could agree that they will not apply certain international safety rules in trades between them. The view underestimates the effect of flag States’ violations of the existing IMO rules that are inherent in this strategy and that distinguish this case from earlier unilateral initiatives to put regulatory pressure on IMO.[[52]](#footnote-52) It is, moreover, quite a divisive strategy, which is bound to foster, and deepen, disagreements between States on how MASS should be regulated at the global level to ensure global consistency that is customary in shipping. In view of this, even a ‘soft law’ solution at the global level, such as a resolution or uniform interpretation, seems more valuable in a jurisdictional sense for facilitating MASS, than a regional treaty, EU regulation, or other type of unilateral ‘hard’ legal act.

## Interim Guidelines

A first development towards authorizing MASS in international waters is the adoption in June 2019 of Interim Guidelines for MASS Trials to assist authorities and stakeholders with ensuring that trials of MASS “are conducted safely, securely and with due regard for the protection of the environment.”[[53]](#footnote-53) The Interim Guidelines include no geographical delimitation of the area where such trials may take place, indicating that they may be conducted both on ships engaged on international routes and on the high seas.[[54]](#footnote-54) The term ‘trial’ is defined as

an experiment or series of experiments, conducted over a limited period, in order to evaluate alternative methods of performing specific functions or satisfying regulatory requirements prescribed by various IMO instruments, which would provide at least the same degree of safety, security and protection of the environment as provided by those instruments.[[55]](#footnote-55)

The definition highlights the temporary nature of the trials, but offers no guidance as to their maximum duration. Trials are closely tied to existing IMO instruments. Their stated purpose is to assess alternative methods to comply with IMO rules and the aim is to find mechanisms to ensure at least an equivalent level of safety. That aim by its nature suggests that all IMO standards *cannot* be complied with during the trial. Accordingly, the Interim Guidelines fall short of requiring full compliance with every provision of the IMO instruments. In paragraph 2.2.1 it is provided that “[c]ompliance with the *intent* of mandatory instruments should be ensured,” while paragraph 2.3.1 similarly holds that “[a]ppropriate steps should be taken to ensure that the *intent* of minimum manning requirements is met” (emphases added). Arguably, the main intent of international watchkeeping and lookout rules is to ensure safe operations of ships at all times, and the requirements of physical presence by humans are only means to that end. If equivalent safety can be ensured by other means, the implication is that trials may be approved even if MASS do not comply with some of the current STCW and COLREGs requirements during the trials.

 The interests of other parties who may be concerned by the trials are mainly addressed in the form of prior information and notification. Under paragraph 2.6 of the Interim Guidelines “[r]easonable steps should be taken to ensure that potentially impacted third parties are informed of the trial of MASS systems and infrastructure,” while paragraph 2.8.1 provides that “[d]etails of trials should be reported to the relevant authorities, as appropriate, as early as practicable, so as to enable the dissemination of information on the trials to all impacted parties in the specified area.” The Interim Guidelines also require strategies to be developed for each trial to “mitigate the effects of incidents and/or failure of systems, technology and testing” which “should include the ability to respond to emergencies.” In this respect, it is further provided that “[i]nformation related to the ship’s performance and the basis of judgement by automated systems should be available to any personnel involved in MASS trials, whether remote or on board.”

 The legal significance of the Interim Guidelines is uncertain, notably regarding whether they can serve to legitimize MASS operations beyond the national waters of States. On the one hand, the Interim Guidelines, adopted in the form of a circular by the IMO’s Maritime Safety Committee, represent a very low key ‘soft law’ instrument with no legal force as such.[[56]](#footnote-56) Clearly, international legally binding rules cannot be set aside or amended by the Interim Guidelines.

 On the other hand, the Interim Guidelines clearly represent an endorsement on behalf of the international maritime community that trials may be carried out under certain conditions and that those conditions neither confine the trials to national waters nor involve full compliance with existing IMO rules. It was further noted above that even non-legally binding rules may form part of the ‘generally accepted international rules and standards’ referred to in UNCLOS and hence entail legal implications as the minimum standard for flag States and maximum standard of coastal State regulation.[[57]](#footnote-57) Trials conducted on the basis of the Interim Guidelines will thus strengthen flag States’ arguments that they are acting in compliance with generally accepted international rules and standards. Conversely, the basis for other States to claim that the trial is not in compliance with IMO rules will be correspondingly reduced.

 Whether that can be taken as far as meaning that the parties to individual IMO conventions have agreed to trials involving diversions from their provisions, as long as the ‘intent’ of those rules is ensured, is far from clear. Under the VCLT subsequent agreements and practice, including in the form of resolutions, can be taken into account in interpreting treaties,[[58]](#footnote-58) but contradicting a treaty’s wording goes beyond interpretation.

 The matter gets more complex still in the context of international watchkeeping standards, since STCW Regulation I/13 refers to the possibility for flag State to make exemptions for trials on certain conditions, one of which is that the trial is conducted “in accordance with guidelines adopted by the [IMO].”[[59]](#footnote-59) While the negotiating history of that provision points to earlier experiments with a single person on watch in hours of darkness,[[60]](#footnote-60) there is nothing in the provision that would exclude the Interim Guidelines for MASS trials from its scope. If so, the guidelines might even be the subject of indefinite trials, provided that a number of procedural requirements are met, including close involvement of the IMO and respect of any potential objections by other parties.[[61]](#footnote-61)

In any case, it is clear that experimental trials foreseen in the Interim Guidelines will not provide a permanent solution for authorizing MASS in international waters. Proper endorsement of MASS requires a more solid legal backing, both in the form of formal convention amendments and through unified interpretations or guidelines, depending on the nature of the tension between MASS and the existing provision in question.

 That said, the brief analysis above illustrates that the Interim Guidelines represent a potentially important first step towards introducing MASS in international waters, which in itself is significant. The absence of a geographical delimitation of the trial areas also raises the prospect that large sea areas surrounded by several coastal States favorable to MASS development could be the scene for individual trials on a more permanent basis. There is nothing in the text of the Interim Guidelines to exclude that prospect, as long as each individual trial meets the conditions for trials.[[62]](#footnote-62) A more generic trial area could be a prospect for sea areas such as the Baltic Sea that does not have transit traffic heading beyond its coastal States and which is fully covered by maritime zones belonging to the coastal States.

## National or Regional Rejection of MASS

A very different question is whether coastal States that are *not* favorable to the development of MASS could use their jurisdiction under the law of the sea to limit the operation of foreign MASS in their coastal waters or even prevent them from entering those waters. For States opposing the introduction of MASS, the latter may be an effective strategy to obstruct the development.[[63]](#footnote-63)

 It was noted in section 4 above that coastal/port States have broad jurisdiction derived from their territorial sovereignty over foreign ships that are voluntarily present in one of its ports or internal waters. In view of this, a State is entitled (unless it has accepted specific obligations to the contrary) to refuse access by foreign MASS to its ports or internal waters, provided that the refusal complies with certain more general criteria of reasonableness that exist in general international law, such as non-discrimination, proportionality between the measure and its objective and that the prohibition does not constitute an abuse of right.[[64]](#footnote-64) This may turn out to be a significant limitation of the freedom of movement of MASS, but the limitation is by no means unique to such ships. Port States may on the same conditions refuse the entry of ships of any other type or risk profile.

 As for the territorial sea, the key question is whether the autonomous status of the ship affects its right of innocent passage. Under Article 19(1) passage is deemed to be innocent, as long as it is not “prejudicial to the peace, good order or security of the coastal State.” A list of activities that are considered to be prejudicial to those objectives is given in Article 19(2), which focuses on ships’ activities (such as the use or threat of force, military activities, fishing activities or any act of willful and serious pollution contrary to UNCLOS). None of those activities are typical for, or even likely to be of relevance to, MASS. The fact that the ship has a different risk profile than other ships does not in itself affect its right of innocent passage under UNCLOS.[[65]](#footnote-65) However, as was already noted, ships with a perceived higher risk may be required to follow designated sea lanes and the right of innocent passage may, under certain conditions, be temporarily suspended in specified areas (Article 25(3)).

 Apart from the right of innocent passage, a coastal State’s right to regulate foreign ships in its territorial sea is also subject to other important limitations in terms of legislative and enforcement jurisdiction. While the coastal State can regulate “the safety of navigation and the regulation of marine traffic,”[[66]](#footnote-66) the second paragraph of the same article provides that “such laws and regulations shall not apply to the construction, design, manning or equipment of foreign ships unless they are giving effect to generally accepted international rules and standards” (Article 21(2)). The latter rule mainly serves to ensure that coastal States will not impose national standards that in effect limit the right of innocent passage by placing higher unilateral standards on ‘static’ matters that the ship cannot control in the course of its passage. However, in the present context the wording suggests that in the absence of such international rules and standards, coastal State regulation on construction, design, equipment and manning of ships is also ruled out. A coastal State can therefore not currently impose particular requirements on, e.g., the remote operation of ships, or electronic lookout equipment, etc., for MASS in their territorial sea. Yet, a coastal State may clearly under the same provision insist that foreign ships comply with global minimum standards by requiring that they comply with existing international rules on, e.g., lookout and watchkeeping while in its territorial sea, which under the current legal situation would effectively serve to rule out MASS.

 Even without such national rules, Article 21(4) requires all ships exercising their right of innocent passage to comply with “all generally accepted international regulations relating to the prevention of collisions at sea.” As has been noted above, it may well be argued that features such as technology-based lookout or algorithm-based collision avoidance decisions fail to comply with the current COLREGs.

 Yet, non-compliance with international requirements does not in itself strip a ship of its right of innocent passage. The mere fact that a ship does not meet the SOLAS or COLREGs standards is not, under UNCLOS, sufficient to deny its right of passage. However, since the elaboration of UNCLOS, a more permissive opinion on this matter appears to have gained ground, in legal literature[[67]](#footnote-67) as well as in State practice.[[68]](#footnote-68) The idea of depriving ships that are only *potentially* harmful of their right of innocent passage has gained some support in an environmental context.[[69]](#footnote-69) In any case, MASS that fail to comply with coastal State laws adopted in accordance with UNCLOS are subject to other types of enforcement jurisdiction by the coastal State, falling short of denial of innocent passage, including enforcement measures under Article 211(2), and subsequent enforcement measures by port States.

 In a (future) scenario where IMO has modified its key conventions to authorize the operation of MASS, coastal States’ possibilities to deny MASS the right of passage through their territorial sea will be more limited. In this case, the argument would need to be that passage of MASS is “prejudicial to the peace, good order or security of the coastal State” under Article 19(1) and therefore not innocent. Certain types of MASS may very well include features to justify such claims.[[70]](#footnote-70) For commercial ships, the more likely claim would be that MASS with no crew members on board not only fail to comply with UNCLOS Article 94, but also represent a new type of security concern in view of the limited access to traditional enforcement measures, such as visits, inspections and arrest of the ship and its crew. The balancing of interests in this regard is likely to be particularly delicate in the early (trial) phases of MASS operations and may well result in calls for additional assurances to satisfy the concerns of skeptical coastal States.

 The jurisdiction of States bordering ‘straits used for international navigation’ is more constrained, in particular with respect to ships exercising their right of transit passage. Here, too, coastal State jurisdiction covers the safety of navigation and the regulation of traffic (Article 42(1)(a)), but there are no specific provisions for ships representing particular certain risks. Ships exercising the right of transit passage must adhere to such rules by the coastal States (Article 42(4)) and to generally accepted international maritime safety rules and standards, including the COLREGs (Article 39(2)). Nevertheless, the right of transit passage is not explicitly dependent on compliance with such rules. In line with this ambiguity, UNCLOS Part III includes no provision on the at-sea enforcement of violation of these rules.[[71]](#footnote-71) As long as the ship meets the conditions of transit passage, which is defined as “the exercise of freedom of navigation ... solely for the purpose of continuous and expeditious transit of the strait,”[[72]](#footnote-72) it is only stated that passage shall not be impeded (Article 38(1)) and that bordering States shall not hamper or suspend transit passage (Article 44). In view of this, it does not seem possible for States bordering an international strait to interfere with the passage of MASS exercising their right of transit passage through the strait, if the objection only relates to failure by the MASS to comply with certain international safety standards. Here, too, however, other types of enforcement measures, e.g., by port States, will be available to deal with the alleged infraction at a later stage.

 The jurisdiction of coastal States to deny MASS access to their EEZ is even more limited. In this zone, freedom of navigation for all States applies, in so far as otherwise is not specifically provided and subject to having due regard to the interest of other States (Article 58). The most express prescriptive jurisdiction of coastal States over foreign ships in the EEZ concerns laws aimed at the protection of the marine environment and even here, coastal States’ jurisdiction is limited to prescribing rules that give effect to international rules (Article 211(5)). Similarly, enforcement measures are limited to requiring information (Article 220(3)), save for the most serious cases of pollution and damage where the coastal State may exceptionally interfere in the passage (Article 220(5)).

 In conclusion, it seems uncontestable that coastal States may choose not to permit MASS into their internal waters and ports. For the sea areas beyond that, the jurisdiction of coastal States is more limited and the right to regulate foreign MASS depends largely on the extent to which the MASS in question complies with the applicable IMO rules. However, passage rights through the territorial sea of foreign States is not necessarily linked to full compliance with coastal State regulations or international standards, which weakens the right of coastal States to interfere with passage rights for MASS in the territorial sea, including international straits, as does the relative absence of clear enforcement powers for dealing with violations of national or international safety rules. Moreover, even if MASS were to comply with international standards, the more generic security-related provisions of UNCLOS could provide jurisdiction for States to question the right of innocent passage of MASS. In the EEZ, the jurisdiction of coastal States to interfere with MASS in their coastal waters is limited to environmental concerns and therefore unlikely to be relevant.

 The Interim Guidelines on MASS trials may contribute to the presence of MASS in other States’ coastal waters in the near future, but they do not unequivocally require authorization by the coastal State.[[73]](#footnote-73) The very existence of the guidelines reduces coastal States’ argument that the operation of MASS contravenes IMO rules. In this respect it is interesting that STCW Regulation I/13 which addresses trials involving reduced watchkeeping, specifically provides an opportunity for States to object to such trials in advance.[[74]](#footnote-74) Paragraph 7 of the regulation then requires a flag State to respect such objections “by directing ships entitled to fly its flag not to engage in a trial while navigating in the waters of a coastal State which has communicated its objection to the Organization.” Apart from the uncertainty that follows from the undefined term “waters of a coastal State,” this provision is obviously difficult to apply in a MASS context where the trial concerns completely unmanned ships.

 In practical terms, however, the most important ways for States to prevent the operation of MASS in their waters may not be through legal limitations. Policy announcements tend to be as effective for keeping unwanted ships away from the maritime zones of coastal States, independently of the solidity of their legal basis. But even the law of the sea offers means for States to protest against the presence of such ships in their waters, in particular if those ships fail to comply with international standards. Enforcement could, for example, be taken at a later stage, either through subsequent in-port enforcement measures in one of its own ports or through collaboration between several like-minded port States.

#

# 5. CONCLUSION

The operation of autonomous ships in an international context is not yet lawful under current international law, as several legal issues stand in the way before flag States can be allowed to operate MASS. Most, if not all, those issues could be resolved by appropriate action at the global level by the IMO. The review of various challenges linked to the authorization of MASS has highlighted the important role of the IMO, both in a technical and a jurisdictional sense.

 With respect to the technical legal challenges, it is observed that rather few of the existing IMO rules pose direct conflicts with MASS. The prime example of conflict in the field of manning are the physical presence requirements for watchkeeping staff in STCW Chapter VIII, while the main challenges for increased automation lie in certain provisions in COLREGs as these presume the presence of humans in the decision-making loop. Apart from this, several of the key maritime safety conventions include requirements that can only authorize MASS if understood and interpreted in a particular way. This, too, requires action at the IMO level, albeit that the spectrum of available regulatory tools is larger in this case as ‘softer’ legal solutions than formal regulatory amendments will normally suffice to achieve the desired result.

 The crucial role that IMO plays in legalizing MASS is further highlighted in the international law of the sea. It is concluded that a key factor determining the legality of MASS is whether such ships are permitted under the generally accepted international rules and standards, which in reality is a shorthand for IMO rules. Through such references in several parts of UNCLOS, IMO is granted a central regulatory role, while UNCLOS maintains its function as a living, dynamic constitution that can be adapted to technological developments and the evolving needs of the international community, without compromising the international nature of regulation of shipping. By contrast, other regulatory entities, such as coastal States or regional organizations, have very little opportunities for independent regulation of this matter, at least outside the limits of their territorial sea. This applies both for coastal States seeking to advance the development of MASS and those seeking to limit the presence of foreign MASS in their coastal waters. In both cases, the relevant level of regulation that can be applied is highly dependent on existing IMO standards. Even soft law instruments adopted by the IMO carry more legal weight for authorizing MASS internationally than legally binding instruments of only regional scope.

 The recently adopted Interim Guidelines for MASS trials may turn out to be the starting point for introducing MASS into international waters and it has been shown above that their adoption may entail some legal consequences, despite their modest value as an independent source of international law. At the very least, the Interim Guidelines illustrate that the international maritime community is not unfavorable towards testing new technologies, provided that sufficient precautions to maintain safety levels are taken.

 For authorizing permanent applications of MASS, more solid legal instruments by IMO will be required. Apart from addressing the existing legal obstacles to the introduction of MASS, the main regulatory challenge for IMO will probably be to set out a legal framework for all the novel elements that MASS brings about. These include the setting of standards for matters such as lookout by means of technology, standards for remote operation of ships and standards for navigational decision making undertaken by autonomous systems.

 This process has not yet started at IMO, which is still committed to analyzing existing rules through the regulatory scoping exercise for some more years to come. In the meantime, other parties who have an interest in advancing MASS should probably start considering the format and content of the new rules. In any case, it seems inevitable that the completion of a first regulatory regime to authorize MASS will not be in place for many years. That is unfortunate, not least since even partially automated or periodically unmanned ships are in need of a resolution of many of the challenges before they can operate internationally.

 The main risk posed by a widening gap between the expectations of progressive States and the legal reality is that the former start implementing their own solutions as flag States and that MASS eventually becomes subject to different legal definitions and requirements in different parts of the world. The main driver for the introduction of MASS is the technological development that makes MASS possible (only) now, and forms part of a broader trend of digitalization of society. Since this is not going to go away, ignoring the development is not an option for the world’s leading regulator of international shipping. IMO deserves credit for having treated the matter very seriously from the outset. Further credit will be due if and when it shifts its attention from identifying problems in existing (old) rules to resolving the entirely new legal challenges posed by MASS, which need to be addressed before the international deployment of MASS can take place.

Figure 1.—Separation of aspects of automation and indication of the nature of the legal challenge.

Source: The figure has previously featured in H. Ringbom, Regulating Autonomous Ships: Concepts, Challenges and Precedents,” *Ocean Development & International Law* 50, no. 2 (2019), p. 148. Taylor & Francis Group has kindly agreed to its reproduction here. XX



1. \* The author thanks Professors Erik Jaap Molenaar and Erik Røsæg for their helpful comments on an earlier draft. [↑](#footnote-ref-1)
2. See also A. Chircop, “Testing international legal regimes: The advent of automated commercial vessels,” *German Yearbook of International Law* 60 (2017): 109–142. [↑](#footnote-ref-2)
3. IMO Docs. MSC 98/23, MSC 98/20/2 and MSC 98/20/13. [↑](#footnote-ref-3)
4. IMO Doc. MSC 99/WP.9, Annex 1, para. 4. [↑](#footnote-ref-4)
5. In addition to the level of manning and the level of autonomy, a third separate element of the development towards autonomous ships relates to the level of technology of the ship, including e.g., the level of ‘intelligence’ of the shipboard systems and the technical availability for remote operation. This element relates more to the construction phase of the ship than to its operation and has not yet received much attention in the international discussions. Regulation of the level of technology on board ships will not be addressed here, but see section 3 below on the need for new rules. [↑](#footnote-ref-5)
6. STCW Regulation VIII/2(2)(1) requires that “officers in charge of the navigational watch are responsible for navigating the ship safely during their periods of duty, when they shall be *physically present* on the navigating bridge or in a directly associated location such as the chartroom or bridge control room at all times.” (emphasis added). [↑](#footnote-ref-6)
7. See e.g., International Convention on Safety of Life at Sea (SOLAS) Regulation V/34(3) and paras. 2.1.6 and 12 of the International Ship and Port Facility Security Code, which are mandatory under SOLAS Chapter XI-2. [↑](#footnote-ref-7)
8. While the term ‘autonomy’ refers to the independence of the system from human intervention and control, ‘automation’ is used as a more general term for the process towards increased reliance on technology for tasks traditionally carried out by humans. A highly automated ship is therefore not necessarily autonomous (exemplified by a sophisticated dynamic positioning system, designed to assist the crew but not make any operational decisions on its behalf), while autonomous functions releasing the crew from its duty to monitor and control can be achieved by relatively low levels of automation (e.g., by authorizing the use of a ‘smart’ autopilot, that uses radar and other data to avoid coming close to any objects at sea). [↑](#footnote-ref-8)
9. COLREGs, Rules 2 and 8. [↑](#footnote-ref-9)
10. A number of studies have been carried out on the topic in the past few years and the results tend to be fairly uniform. See e.g., CMI study (MSC 99/INF.8); Danish study (MSC 99/INF.3). For a compilation of relevant studies by the IMO Secretariat, see IMO Doc. MSC 100/INF.3. [↑](#footnote-ref-10)
11. In the CMI study referred to in note 9, for example, eight different conventions were analysed. Out of the hundreds of provisions analysed in the eight conventions and associated codes, less than ten were considered to require formal amendments to accommodate unmanned ships. [↑](#footnote-ref-11)
12. See STCW Convention, n. 5 above. [↑](#footnote-ref-12)
13. IMO Resolution A.1047(27). [↑](#footnote-ref-13)
14. Id., Annex 2, paras. 1.1.3 and 1.1.4. [↑](#footnote-ref-14)
15. COLREGs, Rule 5. [↑](#footnote-ref-15)
16. The limited possibilities to detect sounds on board ships with enclosed bridges has later been compensated by a requirement to have a technical device on board to identify sounds and their direction in SOLAS Regulation V/19(2.1.8). [↑](#footnote-ref-16)
17. See e.g., M. Bergström et al., “Towards the Unmanned Ship Code,” in P. Kujala and L. Lu, eds., *Marine Design XIII, Volume 2: Proceedings of the 13th International Marine Design Conference (IMDC 2018), June 10–14, 2018*, (Helsinki: CRC Press, 2018), available online: <http://www.crcpress.com/Marine-Design-XIII-Volume-2-Proceedings-of-the-13th-International-Marine/Kujala-Lu/p/book/9781138340763>. [↑](#footnote-ref-17)
18. SOLAS Chapter II-1, Part E. The matter remained governed by non-legally binding IMO resolutions for a long time before the rules were eventually incorporated into SOLAS. See also H. Ringbom, Regulating Autonomous Ships: Concepts, Challenges and Precedents,” *Ocean Development & International Law* 50, no. 2 (2019), p. 152. [↑](#footnote-ref-18)
19. IMO Doc. MSC 101/WP.8, Annex 3. [↑](#footnote-ref-19)
20. As of August 2019, UNCLOS had 168 parties, including the European Union. [↑](#footnote-ref-20)
21. For a comprehensive study of this and other key references used in UNCLOS, see the Final Report of the International Law Association’s Committee on Coastal State Jurisdiction relating to Marine Pollution over Vessel-Source Pollution, 2000 (ILA Report), available online: <http://www.ila-hq.org/en/committees/index.cfm/cid/12>. [↑](#footnote-ref-21)
22. These terms are not defined in UNCLOS, but it follows from the nature of the activities carried out by the ships here under consideration that they would most likely be regarded as vessels/ships by virtue of their size, features and functions. Neither international conventions nor national rules defining the term ‘ship’ include references to crewing. See also R. Veal and H. Ringbom, “Unmanned ships and the international regulatory framework,” *The Journal of International Maritime Law* 23, no. 2 (2017): 100–118, who argue that “it would seem unjustified that two ships, one manned and the other unmanned, doing similar tasks involving similar dangers would not be subject to the same rules, which have been designed to address those dangers” (p. 102). [↑](#footnote-ref-22)
23. See e.g., IMO Doc. MSC.99/5/1 submitted by the International Federation of Ship Masters’ Associations and the International Transport Federation. [↑](#footnote-ref-23)
24. UNCLOS, Article 94(1). [↑](#footnote-ref-24)
25. UNCLOS, Articles 94(3)(b) and 94(4)(b). [↑](#footnote-ref-25)
26. See e.g., the Danish study (MSC 99/INF.3) referred to in n. 9 above, p. 23. [↑](#footnote-ref-26)
27. UNCLOS, Article 94(5). See also Article 211(2). [↑](#footnote-ref-27)
28. See CMI questionnaire of 2017 summarized in IMO Doc. MSC 99/INF.8 referred to in n. 9 above, wherein ten out of twelve responding States’ maritime law associations took a similar view of UNCLOS and considered that the IMO has the formal competence to regulate unmanned ships. [↑](#footnote-ref-28)
29. See at n. 12 above. [↑](#footnote-ref-29)
30. Section 2 above. [↑](#footnote-ref-30)
31. As of August 2019, UNCLOS had 169 parties, including the European Union, while all three IMO conventions discussed here (SOLAS, COLREGs and the STCW Convention) had more than 160 parties, representing the flag States of more than 99 percent of the tonnage of the world’s merchant fleet. [↑](#footnote-ref-31)
32. The main rule in the law of treaties is spelled out in Article 26 of the Vienna Convention on the Law of Treaties (VCLT): “Every treaty in force is binding upon the parties to it and must be performed by them in good faith.” See also notes 48 and 57 below. [↑](#footnote-ref-32)
33. For example, SOLAS Reg. I/1(a). [↑](#footnote-ref-33)
34. UNCLOS, Articles 18 and 19. [↑](#footnote-ref-34)
35. UNCLOS, Article 25(3), referring specifically to weapon exercises. Such suspension shall take effect only after having been duly published. [↑](#footnote-ref-35)
36. UNCLOS, Article 22(1). See also Article 22(4): “The coastal State shall clearly indicate such sea lanes and traffic separation schemes on charts to which due publicity shall be given.” [↑](#footnote-ref-36)
37. UNCLOS, Article 21(1) and (4). [↑](#footnote-ref-37)
38. COLREGs Rule 1(a) provides that the rules “shall apply to all vessels upon the high seas and in all waters connected therewith navigable by seagoing vessels.” [↑](#footnote-ref-38)
39. See UNCLOS, Article 38(2). [↑](#footnote-ref-39)
40. UNCLOS, Article 34. [↑](#footnote-ref-40)
41. UNCLOS, Articles 41 and 42(1)(a). [↑](#footnote-ref-41)
42. UNCLOS, Article 44. [↑](#footnote-ref-42)
43. UNCLOS, Articles 39 and 42(4). [↑](#footnote-ref-43)
44. UNCLOS, Article 39(1)(c). [↑](#footnote-ref-44)
45. UNCLOS, Article 44. [↑](#footnote-ref-45)
46. See Marine Insight, available online: <https://www.marineinsight.com/shipping-news/mua-questions-amsas-motivations-autonomous-vessels>, where Australian Maritime Safety Authority chief executive Mick Kinley is reported to say that he “expected bilateral agreements between countries for the navigation of autonomous vessels within their waters before there was international regulation on the matter.” See also the statement at the Norwegian Forum for Autonomous Ships, available online: <http://nfas.autonomous-ship.org/why-en.html>: “In reality, one may go a long way when autonomous ships are operated in national (as Yara Birkeland) or regional waters where one can manage with bilateral agreements between flag state, coast staes (sic) and port states, but general international shipping will be difficult to do without significant changes in today’s regulations and contractual arrangements.” [↑](#footnote-ref-46)
47. H. Ringbom, *The EU Maritime Safety Policy and International Law* (Leiden: Brill Nijhoff, 2008). [↑](#footnote-ref-47)
48. In theory it may be possible for coastal States to accept international trade by MASS between one or more States if the voyage can be made exclusively within the internal waters or territorial sea of the States concerned and all coastal States are prepared to accept the arrangement. However, this possibility is not likely to be of any practical significance. [↑](#footnote-ref-48)
49. Under Article 41(1) of the VCLT, two or more of the parties to a treaty may conclude an agreement to modify the treaty as between themselves alone only if the possibility of such a modification is provided for by the treaty” or if “the modification in question is not prohibited by the treaty,” “does not affect the enjoyment by the other parties of their rights under the treaty or the performance of their obligations,” and “does not relate to a provision, derogation from which is incompatible with the effective execution of the object and purpose of the treaty as a whole.” See also rules to the same effect in UNCLOS, Article 311(2–4). [↑](#footnote-ref-49)
50. UNCLOS, Article 94(7). [↑](#footnote-ref-50)
51. Barcelona Traction, Light and Power Company, Limited (Belgium v. Spain), International Court of Justice, 1970. See also Article 48(1)(a) of the Articles on State Responsibility. In the more recent Arctic Sunrise Arbitration from 2015, available online: <http://www.pcacases.com/web/sendAttach/1438> the Netherlands argued that it is “in the interest of all States collectively that the seas beyond a coastal State’s territorial waters remain open for navigation and that such navigation be enjoyed peacefully and without unlawful impediment” (para. 182). This matter was not further examined by the Arbitral Panel, however (para. 182). [↑](#footnote-ref-51)
52. Even if the route of the MASS were to be confined to the territorial waters of the States involved, legal concerns could still arise, since in that case the MASS would be the ship *exercising* the rights of innocent and transit passage in other States’ waters, invoking the duties to comply with international rules as required in Articles 21(4) and 39(2). This contrasts with the scenario discussed in section 4 above, in which the MASS would operate permanently in the territorial sea of a coastal State and would therefore not be in international traffic. [↑](#footnote-ref-52)
53. IMO Doc. MSC 101/WP.8, Annex 3. [↑](#footnote-ref-53)
54. This is also supported by para. 1.2.3, providing that “[i]t is the responsibility of the flag State Administration to authorize a ship to participate in a trial. Where necessary, authorization should also be obtained from the coastal State and/or port State authority where the trial will be conducted.” The role of coastal States is thus left very unclear, but based on the jurisdictional analysis above, their authorization seems necessary at least if trials are to be carried out in their internal waters and probably in their territorial sea. [↑](#footnote-ref-54)
55. Id., para. 1.2.2. [↑](#footnote-ref-55)
56. IMO Doc MSC.1/Circ. XX (no number yet). [↑](#footnote-ref-56)
57. See the ILA Report referred to in n. 20 above. [↑](#footnote-ref-57)
58. Under the general rule of treaty interpretation, as laid down in Article 31 of VCLT, the focus is on the terms of the treaty in their context. However, under para. 3, “[t]here shall be taken into account, together with the context: (a) any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions; (b) any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation; (c) any relevant rules of international law applicable in the relations between the parties.” [↑](#footnote-ref-58)
59. STCW Regulation I/13(3) and (8)(2). [↑](#footnote-ref-59)
60. See Ringbom, n. 17 above, pp. 150–152. [↑](#footnote-ref-60)
61. STCW Regulation I/13(8). [↑](#footnote-ref-61)
62. Indeed, as noted by the International Transport Federation in IMO Doc. MSC 101/5/1, para 3, “the primary focus of the interim guidelines should be trials of large commercial ships on extended international voyages outside of national regulation in the time period before international regulations accommodating MASS come into effect. The interim guidelines may be viewed as a potential interim first step to new international regulations.” [↑](#footnote-ref-62)
63. Such opposition by coastal States eventually terminated the initiative to permit one-person-watches during hours of darkness in the 1990s, referred to at n. 59 above. [↑](#footnote-ref-63)
64. UNCLOS, Article 300. [↑](#footnote-ref-64)
65. Notably UNCLOS Article 23 requiring “foreign nuclear-powered ships and ships carrying nuclear or other inherently dangerous or noxious substances” while exercising their right of innocent passage to “observe special precautionary measures established for such ships by international agreements. See also Article 22(2). [↑](#footnote-ref-65)
66. UNCLOS, Article 21(1)(a). [↑](#footnote-ref-66)
67. See e.g.m ILA Report referred to in n. 20 above, pp. 494–495 and K. Hakapää and E.J. Molenaar, “Innocent passage: Past and present,” *Marine Policy* 23, no. 2 (1999): 131–145 with further references. [↑](#footnote-ref-67)
68. See ILA Report, n. 20 above, p. 496 and Hakapää and Molenaar, id., p. 140. [↑](#footnote-ref-68)
69. See e.g., E.J. Molenaar, “Navigational rights and freedoms in a European regional context,” in D.R. Rothwell and S. Bateman, eds., *Navigational Rights and Freedoms in the New Law of the Sea* (The Hague: Kluwer Law International, 2000, pp. 27–31; and A.K-J. Tan, *Vessel-Source Marine Pollution: The Law and Politics of International Regulation* (Cambridge: Cambridge University Press, 2006), p. 208. The seventh conclusion of the ILA Report referred to in n. 20 above, pp. 493–495, provides that “a ship whose condition is so utterly deplorable that it is extremely likely to cause a serious incident with major harmful consequences, including to the marine environment” is considered to be in passage which is prejudicial to the peace, good order or security of the coastal State and, consequently, loses its right of innocent passage. According to K. Hakapää, “Jurisdictional developments and the Law of the Sea Convention: Some observations on vessel-source pollution,” in M.H. Nordquist, J.N. Moore and S. Mahmoudi eds., *The Stockholm Declaration and Law of the Marine Environment* (The Hague: Kluwer Law International, 2003), p. 280, [t]his would seem to be common sense even if a strict reading of [UNCLOS] could command otherwise.” [↑](#footnote-ref-69)
70. MASS could, for example, be constructed in smaller sizes, and in other forms more difficult to detect and monitor, which would make them particularly suitable for espionage, smuggling and other non-innocent activities. [↑](#footnote-ref-70)
71. But see UNCLOS, Article 38(3) under which “any activity which is not an exercise of the right of transit passage through a strait remains subject to the other applicable provisions of this Convention.” See also the safeguard included in Article 233, permitting the bordering States to take “appropriate measures” if a ship exercising its right of transit passage has violated its pollution standards in a way that threatens to cause major damage to the marine environment of the straits. [↑](#footnote-ref-71)
72. UNCLOS, Article 38(2). [↑](#footnote-ref-72)
73. See n. 53 above. [↑](#footnote-ref-73)
74. See n. 58 above, para. 6. [↑](#footnote-ref-74)