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Uncharted Waters: Addressing the Regulatory Gaps in Part VII of UNCLOS in the Advent of Maritime Autonomous Surface Ships

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This bachelor's thesis examines the regulatory gaps in the United Nations Convention on the Law of the Sea in relation to the new technological innovation of Maritime Autonomous Surface Ships. The role of the Convention is important as it provides the general framework for all maritime operations. The autonomous nature of these modern vessels challenges the human-centric assumptions of the old Convention and prompts the need to re-evaluate its provisions in light of the new technological advancements.

By analysing the provisions regarding general maritime principles and piracy in Part VII of UNCLOS, the thesis seeks to answer the question of whether or not the Convention remains an adequate legal instrument for regulating maritime operations in the advent of autonomous vessels. To aid in this task, the study employs the critical doctrinal method 'Gaps, Conflicts and Ambiguities' by Jorge L. Esquirol. The legal gaps that are discovered are reconciled through different forms of legal interpretation.

The study found that while the shift to autonomous shipping creates gaps and ambiguities in the existing law of the sea regime, UNCLOS remains an adequate legal instrument for regulating maritime activities. The Convention therefore maintains its status as a framework convention for the law of the sea.

Tämä ON-tutkielma tarkastelee itseohjautuvien laivojen aiheuttamia sääntelyaukkoja Yhdistyneiden kansakuntien merioikeusyleissopimuksessa. Yleissopimuksella on tärkeä merkitys merenkulun toimintoja käsittelevänä yleisenä puitesopimuksena. Nykyaikaisten alusten autonominen luonne haastaa vanhalle yleissopimukselle ominaisia ihmiskeskeisiä oletuksia ja luo tarpeen arvioida sen määräyksiä uudelleen teknologian kehityksen valossa.

Tarkastelemalla yleissopimuksen VII-osan säännöksiä yleisistä merioikeudellisista periaatteista ja merirosvoudesta, tutkielma pyrkii vastaamaan kysymykseen siitä, onko yleissopimus riittävä oikeudellinen instrumentti merenkulun sääntelyyn itseohjautuvien laivojen yleistyessä. Tarkastelun tukena käytetään Jorge L. Esquirolin kriittistä metodia 'Gaps, Conflicts and Ambiguities'. Havaitut lain epäselvyydet pyritään ratkaisemaan oikeudellisen tulkinnan keinojen avulla.

Tutkimus osoitti, että vaikka siirtyminen autonomiseen merenkulkuun luo aukkoja ja epäselvyyksiä nykyiseen merioikeusjärjestelmään, UNCLOS säilyy riittävänä oikeudellisena instrumenttina yleisluontoiseen merenkulun toimintojen sääntelyyn. Yleissopimus säilyttää siten asemansa merenkulkua koskevana puitesopimuksena.

Keywords / Avainsanat:

law of the sea, autonomous vessels, international conventions, legal principles, piracy

merioikeus, itseohjautuvat laivat, kansainväliset sopimukset, oikeusperiaatteet, merirosvous

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List of Abbreviations

IMO	International Maritime Organization
ITLOS	International Tribunal for the Law of the Sea
MASS	Maritime Autonomous Surface Ship
MSC	Maritime Safety Committee
RSE	Regulatory Scoping Exercise
SOLAS	International Convention for the Safety of Life at Sea
SUA	Convention for the Suppression of Unlawful Acts of Violence Against the Safety of Maritime Navigation
UNCLOS	United Nations Convention on the Law of the Sea

1 Introduction

1.1 Background and context of the study

Technological innovations have increased rapidly in the maritime industry over the past decades, and among the most significant developments are Maritime Autonomous Surface Ships (MASS). These autonomous vessels are designed to operate on various levels of autonomy, ranging from remotely controlled to fully autonomous, and they present a massive shift on the maritime industry as a whole. The technology promises improvements in cost-effectiveness, environmental impact and safety in navigation, and as a consequence, autonomous vessels have been the subject of investments and trial runs around the world.¹

The way these vessels should be integrated into the current maritime industry has been a topic of extensive discussions, as the emerging technology poses questions regarding matters such as safety and cybersecurity. The advent of autonomous vessels also calls for a review of the regulatory frameworks that encompass maritime operations. Such review is necessary to ensure the utmost safety at sea and to reaffirm the obligations and duties of all involved parties. The International Maritime Organization (IMO) has already begun tackling these issues, however, developing new regulations is time-consuming, and new emerging technologies have a habit of outpacing regulatory reforms.

As an overarching treaty on all things concerning the sea, the United Nations Convention on the Law of the Sea (UNCLOS) functions as the constitution for the oceans.² It was drafted between 1973 and 1982 and came into force in 1994, consolidating and replacing the four existing treaties of the 1958 UN Convention on the High Seas. It has so far been ratified by 168 states, and it is the most important legal document concerning maritime operations.

The purpose of UNCLOS is to serve as a framework convention that establishes a legal order for the seas and ensures the peaceful use of its resources.³ It does this by setting out important maritime principles, such as the freedom of the high seas and right of navigation.⁴ However, the Convention does not prescribe how maritime operations ought to be organized in detail, and its provisions are often enforced through other international treaties. The task of drafting

¹ Allianz Safety and Shipping Review 2018, pp. 40–41.

² The United Nations Convention on the Law of the Sea, 1982.

³ UNCLOS, Preamble.

⁴ UNCLOS, Art 87; UNCLOS, Art 90.

detailed instruments is delegated to other UN agencies through referrals to ‘competent international organizations’ in many of the provisions of UNCLOS.⁵

As the convention was compiled in a completely different societal and temporal context, the text of the Convention may contain a myriad of assumptions regarding maritime matters. Therefore, the emergence of Maritime Autonomous Surface Ships presents the question whether or not UNCLOS remains an adequate tool for regulating maritime activities.

1.2 Research question, method and materials

The aim of this research is to interpret the current legal rules in force and analyse how they complement the newly emerging technology of MASS. The study, therefore, seeks to answer the following research question: ‘Does the United Nations Convention on the Law of the Sea remain an adequate legal instrument for regulating maritime matters in the advent of Maritime Autonomous Surface Ships?’. The study is not exhaustive – the main focus will be on Part VII of UNCLOS that contains general provisions regarding the high seas regime.

While assessing Part VII of UNCLOS, the aim is to analyse the relevant provisions and deem whether or not the gaps MASS creates in them are too severe to negate the aims and purposes of the Convention and therefore hinder its status as a framework treaty. If regulatory ambiguities are found, the conflicts between UNCLOS and MASS will be attempted to resolve through different forms of legal interpretation. If an irreconcilable conflict is found, UNCLOS would be deemed to fail in its aims as set out in its Preamble.

The research will employ the method “Gaps, Conflicts and Ambiguities” as introduced by Jorge L. Esquirol.⁶ This *de lege lata* approach to legal research seeks to highlight the discrepancies of law and to challenge the assumption that legal codes are drafted to address every possible legal question that may arise.⁷ By researching the gaps, conflicts and ambiguities within law, it can be shown that this assumption may not always hold true. This method was deemed appropriate for this study, and it aligns well with the chosen research question. The study is not normative and therefore will not provide recommendations on how

⁵ E.g. UNCLOS, Art 39; UNCLOS, Art 211.

⁶ Esquirol, pp. 1107–1109.

⁷ *Id*, p. 1109.

the law should be developed. Detailed *de lege ferenda* suggestions are thus outside the scope of this study.

In this research, the applied materials include, *inter alia*, international law of the sea conventions, case law of both international and national courts, guidelines of international organizations and writings of legal scholars. Special interest will be paid to the provisions of the United Nations Convention on the Law of the Sea, as well as the guidelines of the Maritime Safety Committee (MSC) regarding Maritime Autonomous Surface Ships.

The thesis begins with an introduction to the context and background of the study in chapter one. This section also establishes the research question, method and materials. Chapter two briefly introduces the technology behind Maritime Autonomous Surface Ships and assesses how the IMO has approached potential gaps in different legal instruments thus far. Chapter three begins the assessment of regulatory gaps in UNCLOS, containing analysis on several core principles of maritime law such as the nationality of ships, duties of the flag state and duty to render assistance at sea. These are fundamental questions to address to ensure that maritime shipping operates safely and efficiently. Finally, chapter four tackles the regulatory gaps through a concrete example of piracy by assessing potential scenarios and jurisdictional issues that might emerge. The study will end with a conclusionary chapter that ties all the discussed topics together.

2 Maritime Autonomous Surface Ships

2.1 The current state of MASS technology

The technological development in the field of Maritime Autonomous Surface Ships has been rapid, as autonomous shipping has progressed from a mere concept to reality during the past decades. The autonomous nature of MASS has been a source of debates and has brought forth contrary opinions on the advantages and disadvantages of the technology. For instance, features incorporated into MASS such as automated decision-making and enhanced situational awareness have the potential to offer significant improvements in maritime safety, as it has been observed that human error is the most common reason for maritime accidents.⁸ Other recognized benefits of MASS are increases in cost-effectiveness, as uncrewed vessels allow for more efficient use of space and therefore consume less fuel.⁹

On the other hand, the technology requires great investments as it needs to achieve regulatory compliance, and building the ships and training of the new remote operators can be costly.¹⁰ Moreover, the addition of new operators such as the remote controller introduces new legal questions on matters such as liability, and it draws into question the status of ancient customary law rules such as the ship master's duty to render aid at sea, as the autonomous nature of the vessels suggests that the ships may operate without a captain on board.

While the technology is still in its cradle, trials of MASS have been conducted around the world. For instance, the fully electric autonomous vessel *Yara Birkeland* is used to transport goods between the Norwegian ports of Herøya and Brevik.¹¹ In Japan, motivated by the nation's aging population, the *MEGURI2040* project has conducted several trials of autonomous vessels operating between ports.¹² As the technology matures, autonomous vessels will become more commonplace.

Despite its current limitations, the impact of MASS on the field of maritime shipping is significant. Rapid development has, however, created a situation where the legal frameworks around maritime shipping cannot keep up with the technological advancements. The work of the Maritime Safety Committee has been crucial in developing regulations and guidelines to

⁸ Sánchez-Beaskoetxea, et al. p. 2.

⁹ Xu and Guedes Soares, p. 7.

¹⁰ *Ibid.*

¹¹ Xu and Guedes Soares, p. 5.

¹² *Ibid.*

make sure that the transition to autonomous shipping would happen in a safe and efficient manner.

2.2 The four levels of autonomy and the work of IMO

To address the increasing deployment of autonomous vessels, the Maritime Safety Committee deemed it important to ensure that the key parties around the development of autonomous vessels had access to a clear and consistent regulatory framework.¹³ Thus, in 2017, the MSC began its Regulatory Scoping Exercise (RSE) regarding Maritime Autonomous Surface Ships. The aim of the exercise was to analyse the existing maritime conventions and deem whether or not they are sufficient for the arrival of autonomous vessels.¹⁴ Moreover, the exercise charted the need for redefinitions regarding the terminology currently in use within the IMO's legal instruments.¹⁵ The RSE provided useful information, such as how different degrees of MASS should be categorized.

Key thing to note is that in the exercise the MSC focused only on conventions created under the IMO. It did not, therefore, expand its analysis to UNCLOS due to its status as the prevailing framework convention. UNCLOS is a general United Nations instrument, and amending its provisions would constitute a much more difficult task on a global level. As detailed in the previous chapter, UNCLOS delegates its power to other IMO instruments, and amending the terms used in these treaties gives the terms in UNCLOS a new meaning through evolutionary interpretation of the Convention.¹⁶

During the exercise, the MSC determined the four different degrees of MASS, where each degree indicates the level of automation the vessel operates under. The first degree covers manned ships that have certain automated processes and decision support mechanisms. On this level some operations may be automated, and the ship can function without supervision at times. Seafarers are still on board, however, ready to take control of the ship in case something unexpected occurs.¹⁷

Under degrees two and three the ship is being controlled remotely. The person operating the ship from a distance is doing so from a specific remote-control center. The difference between

¹³ MSC.1/Circ.1638, para. 2.1–2.3.

¹⁴ *Id.*, para. 3.1.

¹⁵ *Id.*, para. 3.2.

¹⁶ Crawford, pp. 365–366.

¹⁷ MSC.1/Circ.1638, para. 3.4.

the second- and third-degree vessels is that second degree has seafarers available on board the ship ready to take over in case the need for it arises, whereas third degree operates completely crewless.¹⁸ Lastly, degree four refers to fully autonomous ships. This means that the operating system of the vessel is able to determine actions and make all the relevant decisions by itself, and there is no crew on board the ship.¹⁹

On concluding the RSE in 2021, the Maritime Safety Committee identified a multitude of key issues and questions regarding MASS. Due to this, the MSC also highlighted the potential need for a new legal instrument, as amending every other maritime convention separately could lead to regulatory inconsistencies.²⁰ For the interim period, the MSC provided brief guidelines to ensure that MASS trials are conducted safely.²¹ The MSC then started drafting a dedicated MASS Code. Its purpose is to provide an international regulatory framework for Maritime Autonomous Surface Ships to support the safe integration of the new technology, and its enforcement is planned to start in January 2032.²²

The work of the MSC highlights several regulatory gaps in different IMO instruments. The Committee identified several key issues concerning the terminology used in conventions such as the International Convention for the Safety of Life at Sea (SOLAS).²³ For instance, clarifying terms such as the master and crew was deemed a high-priority issue.²⁴ The same terms are used in UNCLOS, which would imply that the same regulatory gaps are present in it as well.

Currently, in the absence of a concrete MASS Code, general instruments such as UNCLOS and SOLAS must be turned to in questions concerning autonomous vessels. Guidelines and outcomes of the RSE still serve their purpose as soft law instruments, however, and can help fill the gaps MASS leaves in legal instruments. The provisions in Part VII of UNCLOS will be analysed more thoroughly in the following chapters.

¹⁸ MSC.1/Circ.1638, para. 3.4.

¹⁹ *Ibid.*

²⁰ *Id.*, para. 6.1–6.2.

²¹ MSC.1/Circ.1604, para. 1.1.

²² MSC 108/20, para. 4.44.2.

²³ The International Convention for the Safety of Life at Sea, 1974.

²⁴ MSC.1/Circ.1638, para. 5.5.

3 General provisions of UNCLOS in relation to MASS

3.1 Nationality and status of the ships

An important question that needs resolving first is whether Maritime Autonomous Surface Ships are considered to be ships in the first place under the framework of UNCLOS, and consequently, whether UNCLOS is applicable when it comes to the different degrees of autonomous shipping. From a technological standpoint, the Convention appears rather neutral. The Convention does not contain an explicit definition of a ship, nor does it detail how ships ought to be operated.

Likewise, UNCLOS does not set clear requirements for ships to always have, for instance, a captain or a crew on board. This seems to be the apparent assumption, however, as several of the articles within the Convention make references to the ship's master and crew.²⁵ The same issue has been noted by the MSC in its Regulatory Scoping Exercise concerning MASS conducted in 2021. Their findings highlighted the need to clarify the terms 'master', 'crew' and 'a responsible person' in relation to various conventions that deal with maritime matters, as autonomous shipping becomes more commonplace.²⁶

Interpreting UNCLOS teleologically, it would be impractical to exclude MASS from the scope of the Convention, as the advancements in technology could alleviate some of the issues concerning maritime shipping today. As discussed in the previous chapter, autonomous ships can be a safer and more efficient alternative to shipping when compared to traditional ships helmed by humans. Therefore, the inclusion of autonomous vessels into the scope of UNCLOS would promote the sustainable development goals of the UN as well as the aims set in the Preamble of UNCLOS.²⁷

The analysis of MASS in relation to UNCLOS continues with the nationality of the ships themselves. Historically, the high seas have been viewed as *res communis*, and the freedom of the high seas has been widely considered a general principle of international law.²⁸ Article 90 UNCLOS highlights this principle, stipulating that every state has a right to sail ships flying

²⁵ E.g. UNCLOS, Art 29; UNCLOS, Art 94.

²⁶ MSC.1/Circ.1638, para. 5.5.

²⁷ UNGA, A/RES/70/1, para. 9.1; UNCLOS, Preamble.

²⁸ Crawford, pp. 281–282.

its flag on the high seas.²⁹ This naturally extends to the varying degrees of autonomous ships as well.

Ships are traditionally required to be bound to a flag state through an act of registration. This principle is codified in Articles 91–92 UNCLOS. According to the Articles, ships must fly the flag of its registration State³⁰, and ships enjoy the nationality of the state whose flag they are entitled to fly.³¹ Moreover, states are free to set the conditions under which ships are registered and nationality is subsequently granted.³²

The nationality of vessels is of utmost importance in matters of jurisdiction and liability. Nationality is what links the conduct of a ship to a state, and this connection is pertinent when situations occur on the international plane that is the high seas. For the high seas regime to function as intended, the registration of vessels is paramount.³³ Moreover, nationality provides certain freedoms to vessels, such as the right to innocent and transit passage. It also protects ships from intrusions on international waters.

Article 91(1) UNCLOS stipulates that there must exist a genuine link between the registration state and the ship.³⁴ How this genuine link manifests is left up for interpretation. In *M/V Saiga (No. 2)*³⁵, the International Tribunal for the Law of the Sea (ITLOS) concluded that the main purpose for the genuine link requirement is to secure more effective implementation of the duties of the flag State.³⁶ Therefore, it is not to be seen as a vector through which the nationality of a ship can be challenged, but instead as a relationship that guarantees that the duties of the flag states are fulfilled.³⁷ In light of the ITLOS judgment, the genuine link requirement should not be viewed as a way to exclude MASS vessels from gaining nationality, but instead as a tool to ensure the ships conform to the safety standards set by the flag states.

It is entirely within the states' purview to set the standards for registration, and the requirements tend to vary greatly between different states. Some states, such as Germany³⁸

²⁹ UNCLOS, Art 90.

³⁰ UNCLOS, Art 92(1).

³¹ UNCLOS, Art 91(1).

³² *Ibid.*

³³ Crawford, p. 515.

³⁴ UNCLOS, Art 91(1).

³⁵ *The M/V Saiga (No. 2) (Saint Vincent and the Grenadines v. Guinea)*, ITLOS Reports 1999, 10.

³⁶ *M/V Saiga (No. 2)*, para. 83.

³⁷ Cogliati-Bantz, pp. 398–399.

³⁸ Official Guide to Ship Registries, Germany.

and China³⁹, have set certain citizenship requirements for the captains and crews of ships seeking registration. The main goal behind these requirements is to ensure the safety of the maritime operations, as the personnel on board are guaranteed to have undergone proper state-mandated training and have therefore acquired the necessary qualifications to operate the ship.

Degrees one and two of MASS pose no apparent issues in regard to ship registration, as ships are still operated by a captain and crew. Degrees three and four prove to be more problematic, however. In these cases, vessels are either remotely operated or completely autonomous, and neither a captain nor crew are required to operate the ship. Due to the lack of seafarers and on-board personnel, the genuine link existing between the ship and the flag state that guarantees the safe fulfilment of duties is now weakened.

By removing the personnel that was previously thought essential for a ship to be registered, MASS leads to the redefinition of the requirements under which vessels are registered and nationality is subsequently conferred. This redefinition should not be seen as a hindrance for autonomous ships to gain nationality, however. The focus should be on maintaining the operational safety of maritime activities by introducing new requirements for the remote operators and developers of the computer systems in charge of the autonomous ships. What is important is that UNCLOS keeps providing an avenue for autonomous vessels to gain nationality, as it is crucial for the high seas regime to operate effectively.

3.2 Duties of the flag state

Article 94 UNCLOS sets out a multitude of obligations for flag states regarding the maritime activities ships under their registration engage in. Broadly, the requirements concern the equipment and training of the personnel on board the ships. From the wording of the Article it is apparent that a human-centric approach is expected when it comes to seafaring activities, and therefore Maritime Autonomous Surface Ships introduce a new lens through which these obligations are viewed through.

Obligations concerning the equipment and seafarers are detailed in Article 94(3) UNCLOS. Flag states are required to take a variety of measures to ensure safety at sea when it comes to the construction, equipment and seaworthiness of ships.⁴⁰ Ships must be manned and crews

³⁹ Official Guide to Ship Registries, China.

⁴⁰ UNCLOS, Art 94(3)(a).

need to be properly trained.⁴¹ The ship must also have proper communication systems in place in order to prevent collisions.⁴² The aforementioned responsibilities are further expanded in Article 94(4).

The most glaring discrepancy between MASS and Article 94 is the presumption that ships are manned by humans. Due to this, MASS poses new challenges when interpreting the Article. Whether the ship falls under degree one or four of MASS, the new technological innovations involved require revisiting these provisions and re-evaluating what the terms contained in them signify.

The term seaworthiness, for instance, was originally meant to describe a state where the ship stays afloat and is capable of travelling between ports. When a vessel is surveyed by a qualified surveyor and is deemed to match all required standards, it is given a certificate, which in turn allows the ship to be registered and used for maritime transport.⁴³ UNCLOS obligates states to ensure that this quality control is appropriately organized. Naturally, autonomous ships must also be seaworthy. Problems arise, however, with Article 94(3–4) UNCLOS, as the Article ties the concept of seaworthiness to a qualified crew. Therefore, textual interpretation of UNCLOS would seem to suggest that ships need to be properly manned in order to be considered seaworthy. This seems to pose an issue for autonomous vessels.

With requirements concerning both seaworthiness and manning of ships, an important thing to note is that the surveyor's evaluation is based on the intended purpose of the vessel.⁴⁴ The vessel must therefore be suitable for the task it is aimed to be used for. Moreover, the main purpose of manning requirements seems to be to guarantee the safety of navigation. For instance, Regulation 13 in Chapter V SOLAS posits that "(...) Governments undertake, each for its national ships, to maintain, or, if it is necessary, to adopt, measures for the purpose of ensuring that, from the point of view of safety of life at sea, all ships shall be sufficiently and efficiently manned."⁴⁵ The provisions in UNCLOS should therefore be interpreted in a way that does not exclude the utilization of MASS technology, provided that autonomous vessels

⁴¹ UNCLOS, Art 94(3)(b).

⁴² UNCLOS, Art 94(3)(c).

⁴³ Stevens, p. 244.

⁴⁴ *Id.*, p. 245.

⁴⁵ SOLAS, Ch. V, Reg 13.

can be operated to achieve their intended purpose in a secure manner, and maritime safety can be guaranteed without the use of seafarers on the ship.

Article 94(4)(c) also obligates states to ensure that the personnel on board are aware of international regulations concerning maritime safety and are able to communicate with other entities at sea.⁴⁶ In cases of remotely controlled ships (degree three of MASS) and fully autonomous vessels (degree four), this exerts a lot of responsibility on the remote operator or the artificial intelligence system that controls the vessel. Especially in the latter case, the responsibility of the flag state is heightened, and the computer systems need to be both capable of performing the necessary tasks at sea and be safe to utilize. This sets additional cybersecurity requirements when evaluating a ship's seaworthiness.

As the different degrees of MASS are operated differently than traditional ships, flag states are bound by Article 94 UNCLOS to reassess the qualifications their operators and the ships themselves possess. As UNCLOS is a technology neutral convention, it does not outright exclude the use of MASS vessels, but it introduces the need to re-evaluate the framework under which certifications are granted, and what certain terminology within the convention represents. This is crucial in order to maintain the operational safety of maritime activities.

3.3 Duty to render assistance

The foundations of the duty to render assistance at sea can be traced back to ancient times. Similar obligations can be found in old Rhodian legal texts, originally intended as means to safeguard trade and communications between the trading communities near the Mediterranean Sea.⁴⁷ For a long time, the rules mainly concerned coastal villages' duty to help shipwrecked people, as ships tended to sail close to the shorelines. However, as technology developed and maritime traffic increased, so did the collisions at sea. This prompted a need for the codification of the duty to render aid at sea.⁴⁸

The duty to render aid at sea is widely proclaimed to be a rule of customary international law. The United Nations Convention on the Law of the Sea highlights this principle as well. Article 98(1) UNCLOS stipulates that every State shall require the captain of a ship to render assistance to any person found at sea in danger of being lost and proceed to rescue persons in

⁴⁶ UNCLOS, Art 94(4)(c).

⁴⁷ Papanicolopulu, pp. 154–155.

⁴⁸ *Id.*, pp. 162–163.

distress, as long as it can be done without causing serious danger to the ship, the crew or the passengers.⁴⁹ The latter parts of the Article contain instructions on how to operate in cases of ship collisions⁵⁰ and set certain requirements for coastal states in matters concerning search and rescue capabilities.⁵¹

The provisions in Article 98 UNCLOS do not conflict with degree one of MASS. While the ship is capable of performing certain tasks on its own, the captain and crew are always on board ready to take control of the ship if needed. The same applies when the ship is controlled remotely, as is the case with degree two of MASS. Therefore, under both of these scenarios the personnel on the ship are able to render assistance at sea in case the need for it arises.

Issues begin to form with degrees three of MASS. The wording of Article 98 UNCLOS assumes that the captain and crew are on board the ship if a need to render aid at sea emerges. This is, however, not the case here, as the ship is now controlled remotely and there are no seafarers on board the ship. While it is possible that the person controlling the ship remotely engages the required safety protocols, the process is subject to magnified scrutiny. Under degree four of MASS, the ship is operating completely autonomously, and the rescue operation is dependent on the computer systems functioning properly and the artificial intelligence knowing how to proceed in certain situations.

With degrees three and four, the responsibility of the flag state is heightened. As the autonomous systems are now in charge of rendering assistance, the safety protocols installed into the systems play a key role. As detailed in the previous chapter, these systems need to be kept up to date by the flag state, as obligated by Article 94 UNCLOS. As long as the autonomous vessels are capable of providing aid at sea, the conflict between the wording of Article 98 UNCLOS and the autonomous nature of the vessels can be resolved.

A question emerges of the extent to which a fully autonomous ship should provide assistance in a scenario where such conduct is required. After all, Article 98 UNCLOS maintains the qualifiers "...in so far as he can do so without serious danger to the ship, the crew or the passengers"⁵² and "...in so far as such action may reasonably be expected of him"⁵³ when

⁴⁹ UNCLOS, Art 98(1).

⁵⁰ UNCLOS, Art 98(1)(c).

⁵¹ UNCLOS, Art 98(2).

⁵² UNCLOS, Art 98(1).

⁵³ UNCLOS, Art 98(1)(b).

determining when the master of a ship is obligated to render assistance at sea. In the case of autonomous ships, the role of the master is ambiguous. However, the argument could be made that as the duty to render assistance at sea has historically concerned humans, such actions could not be reasonably expected from an autonomously operating vessel. Naturally, the opposite is also true. There is no duty to render assistance to an autonomous ship, as there are no persons in distress.

Conversely, the opposing viewpoint would be that since autonomously operating ships do not host personnel, no one is at risk during rescue operations, and therefore the duty to attempt a rescue should be heightened. Degrees three and four of MASS could even be used as a tool in search and rescue operations to render aid in situations where providing assistance through regular means would be too risky.

The position taken by the Maritime Safety Committee Working Group in the early drafts of the MASS code seem to reflect this latter point of view. According to the Working Group, autonomous vessels should at least be able to receive distress signals and alert the search and rescue services in case the need for it arises.⁵⁴ The guidelines go even further, stating that a MASS operating with or without a crew on board should have the means to recover persons in distress.⁵⁵ Every MASS vessel should also have specific plans and procedures in place to ensure that the distress calls operate properly.⁵⁶

As demonstrated, the wording of Article 98 UNCLOS contains gaps and ambiguities regarding degrees three and four of MASS. The Maritime Safety Committee's guidelines help clarify these inconsistencies, however. The technology behind MASS has the potential to revolutionize search and rescue operations at sea, but many key terms and concepts concerning the duty to render aid at sea require redefinitions in order for the maritime activities to remain safe for all parties. The addition of a dedicated MASS Code will help ensure that the duty to render assistance at sea remains an important rule of customary international law in the advent of autonomous vessels.

⁵⁴ MSC 108/WP.7, para. 23.2.1.

⁵⁵ *Id.*, para. 23.2.7.

⁵⁶ *Ibid.*

4 Piracy in the age of automation

4.1 Legal framework for piracy

Piracy as a concept has a long history, being as old a phenomenon as maritime trade itself. In the ancient times, the early pirates targeted merchant ships in the Mediterranean Sea, and Vikings carried on the tradition during the Middle Ages by raiding coastal cities in Western Europe. Piracy was at its most prevalent in the Caribbean Sea in the 17th and 18th centuries, as trans-Atlantic trade became more commonplace. The frequency of piratical acts has been dwindling ever since, yet it is still a significant concern in certain parts of the world. For instance, the waters near the Red Sea, the Strait of Malacca and the Somali coast have been known hotspots for piracy in the 21st century. Piracy is still a global issue, however, as attacks are occurring on the high seas all around the world.⁵⁷

Like other forms of criminal activity, piracy is nearly impossible to eradicate, and the advent of automated computer systems introduces a new avenue for criminals to take advantage of innocent seafarers. While providing many opportunities in the realm of efficiency, the autonomous technology also presents a myriad of attack vectors. Other forms of unmanned vehicles, such as self-driving cars, have been shown to be prone to vulnerabilities and cyberattacks. These may appear, for instance, in forms of hacks and remote hijackings.⁵⁸

The computer systems that operate the machinery are often highly interconnected, and the vehicles therefore contain many entry points for attacks. Electronical interference, malware and denial-of-service attacks can all be exploited to cause ships to report inaccurate data or to deny service altogether.⁵⁹ As the maritime shipping industry has become more reliant on internet and electrical communication systems, the cyberattacks targeting ports have increased at a rapid rate.⁶⁰ The 2017 *NotPetya* attack on the shipping giant Maersk is the largest example of such an attack.⁶¹

Maritime Autonomous Surface Ships are no different in this regard and cybersecurity is an issue that needs to be taken seriously, as autonomous vessels' reliance on digital systems enables attacks to be made from a distance. In the field of international law, possible

⁵⁷ MSC.4/Circ.269, Annex 1.

⁵⁸ Simonite, Your Future Self-Driving Car Will Be Way More Hackable.

⁵⁹ Wilson, pp. 164–165.

⁶⁰ Mandra, Ports Increasingly Targeted by Cyberattacks as Maritime Incidents Surge.

⁶¹ Wilson, pp. 158–159.

cyberattacks on these vessels raise various legal questions regarding the issue of piracy. Questions on whether these kinds of attacks constitute piracy and who has the jurisdiction to prosecute hackers are emerging legal concerns regarding MASS.

Piracy is an issue pertaining uniquely to the high seas and other areas of *res communis* that are outside the jurisdiction of any state and typically covers actions such as ship hijackings. Criminal acts conducted at high seas threaten the maritime traffic and therefore hinder the efficient utilization of oceanic resources. The questions revolving piracy need to be addressed as the phenomenon presents a threat to the aims of UNCLOS.

The leading legal instrument regarding piracy is UNCLOS, and it sets the framework for what type of acts constitute piracy and how jurisdiction is assigned. To compliment UNCLOS and to address some of the legal gaps in the existing maritime law framework, the Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA Convention) was created.⁶² It addresses issues regarding those maritime criminal acts that would otherwise fall outside the scope of piracy.

4.2 The two-ship conundrum

The analysis of MASS and piracy begins with Article 101 UNCLOS. The wording of the article is as follows:

Piracy consists of any of the following acts:

- a) any illegal acts of violence or detention, or any act of depredation, committed for private ends by the crew or the passengers of a private ship or a private aircraft, and directed:
 - (i) on the high seas, against another ship or aircraft, or against persons or property on board such ship or aircraft;
 - (ii) against a ship, aircraft, persons or property in a place outside the jurisdiction of any State;
- b) any act of voluntary participation in the operation of a ship or of an aircraft with knowledge of facts making it a pirate ship or aircraft;
- c) any act of inciting or of intentionally facilitating an act described in subparagraph (a) or (b).⁶³

⁶² The Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation, 1988.

⁶³ UNCLOS, Art 101.

Sub-paragraph (a) details acts of piracy and sets certain qualifiers on them, while sub-paragraphs (b) and (c) expand an act of piracy to participation, facilitation and incitement of piratical acts. Much like in the UNCLOS articles mentioned in the chapter three, the underlying assumption seems to be that piratical acts are carried out by humans, towards humans.

The first point of contention are the acts themselves. The article speaks of illegal acts of violence or detention and acts of depredation. As the convention was drafted in the pre-internet era, it is assumed that a typical act of piracy would consist of a crew of a hostile ship taking over another ship through means of violence or threat thereof and having the ship under detainment while carrying out the illegal deeds. With the advent of autonomous technology this needs to be reassessed. Would a remote hack and a subsequent takeover of an autonomous vessel qualify as an act of piracy?

There is nothing in the article that would suggest otherwise. While not necessarily a violent act, a cyberattack that takes over the operating systems of an autonomous vessel in order to redirect or stop its movement to relieve it of its cargo would clearly fall under detention and depredation. The convention is technology-neutral in this regard.

The location from which the hack occurs is of key importance, however. Article 101 introduces a two-ship requirement by qualifying that piratical acts have to be performed “(...) by the crew or the passengers of a private ship (...) on the high seas, against another ship”.⁶⁴ This raises an important distinction between cyberattacks originating from land and attacks originating from on board of another ship on the high seas. Even if the aims and results of the attacks are the same in both scenarios, the legal analysis differs.

This leads into interesting hypothetical scenarios. Imagine first a case where a hacker, situated on board a ship on the high seas, hacks into the on-board navigation systems of an autonomous vessel and stops its movement. Pirates then seize control of the ship and plunder its contents. In a second scenario, a hacker situated on land hacks into the computer systems and gathers location data. He then aids and abets pirates situated at sea by sending them the crucial information, leading to a hijacking of the vessel. Would either of these scenarios classify as a piratical act?

⁶⁴ UNCLOS, Art 101(a); UNCLOS, Art 101(a)(i).

At a cursory glance the analysis seems clear cut. If the hack originates from a ship on the high seas, the two-ship requirement is fulfilled, and the act is considered an act of piracy.

Conversely, a hack originating from land does not seem to satisfy the two-ship requirement, and the act falls outside the scope of piracy. The issue is not quite as simple, however, as United States courts have expanded the geographical scope of piracy in their legal praxis.

In the case *US v. Ali*, the D.C. Circuit Court drew a distinction between piratical acts and facilitating acts.⁶⁵ The court concluded that a person who had aided and abetted acts of piracy by providing translation services to the perpetrators was to be deemed guilty of piracy, even though his conduct did not take place on international waters.⁶⁶ Moreover, the court argued that the geographical qualifiers of UNCLOS Article 101(a)(i–ii) do not apply to participating or facilitating acts, as long as the predicate offence takes place on the high seas.⁶⁷

A similar stance was taken by the Fourth Circuit Court of Appeals in *US v. Shibin*.⁶⁸ Citing different UN Security Council resolutions, the court argued that in order to curb illicit activity on the high seas, the teleological interpretation of UNCLOS highlights the need to investigate and prosecute those who plan and organize pirate attacks.⁶⁹ Moreover, the Security Council itself deemed in its Resolution 1976 that “(...) individuals and entities who incite or intentionally facilitate an act of piracy are themselves engaging in piracy”.⁷⁰

According to U.S. courts, in cases of aiding and abetting piracy the location of the abettor is of little import. The argument is reasonable, as it is a common staple of criminal legal systems around the world to hold both perpetrators and accomplices liable for the same crimes. What logically follows is that a hacker who, for instance, remotely accesses the on-board computer systems in furtherance of a piratical act would himself be committing an act of piracy, no matter where the hack originated from.

Using this chain of argumentation in cases of remote hacking creates peculiar legal inconsistencies, where a hacker is not committing an act of piracy, unless he is doing it in the form of helping someone else commit a piratical act. Due to the two-ship requirement, piracy has historically been seen as an activity requiring multiple perpetrators working in

⁶⁵ *United States v. Ali*, 718 F.3d 929.

⁶⁶ *US v. Ali*, p. 12.

⁶⁷ *Ibid.*

⁶⁸ *United States v. Shibin*, 722 F.3d 233.

⁶⁹ *US v. Shibin*, pp. 18–20.

⁷⁰ UNSC, S/RES/1976, para. 15.

coordination, but it is not unrealistic to assume that it could be done on one's own. Crewed ships that traditionally have required manpower to hijack can in the future operate autonomously. Smaller autonomous ships, such as autonomous fishing vessels could be taken over by a lone operator.

This extends to remote hacking as well. A case where a hacker, working alone and situated on land, remotely takes over a ship would fall outside the scope of piracy. On getting caught the perpetrator would be rightfully prosecuted for relevant crimes, but his actions would not seem to constitute the elements of piracy. This leads to jurisdictional issues that will be discussed in the following chapter.

4.3 Jurisdictional questions regarding piracy

According to Judge Moore in the dissenting opinion in *Lotus*⁷¹, persons participating in acts of piracy are considered *hostis humani generis*, enemies of mankind, whom any nation may in the interest of all capture and punish.⁷² All states, therefore, have the right to prosecute individuals suspected of committing piratical acts, even when lacking a clear jurisdictional nexus. Historically, determining whether or not a state has jurisdiction over matters occurring on the high seas has been highly disputed.⁷³ However, the global condemnation of acts of piracy due to the dangers they present has been fairly consistent throughout the ages.

The distinction between the hypothetical scenarios drawn in the previous chapter is relevant in regard to the matter of jurisdiction. Due to the *sui generis* nature of the crime, all states have universal jurisdiction in matters of piracy. States have a vested interest in bringing outlaws to justice in order to make areas of *res communis* safe for all parties. The inconsistency in a remote hacking committed on its own and in furtherance of another piratical act leads to jurisdictional issues where a person working alone can avoid universal jurisdiction by committing the illegal act on land instead of a ship. This notion is antithetical with the intentions and goals of the piracy provisions of UNCLOS as confirmed by the Security Council.⁷⁴

⁷¹ *The S.S. Lotus (France v. Turkey)*, PCIJ Rep Series A No 10.

⁷² *Lotus*, para. 249.

⁷³ E.g. *Lotus*, para. 2.

⁷⁴ UNSC, S/RES/1976, para. 13–15.

The SUA convention addresses the issue of jurisdiction somewhat by establishing the prosecute or extradite (*aut dedere aut judicare*) rule.⁷⁵ The signatory states are obligated to either prosecute or extradite a person who has committed acts detailed in Article 3 of the convention. According to Article 3(1)(a) SUA, “Any person commits an offence if that person unlawfully and intentionally seizes or exercises control over a ship by force or threat thereof or any other form of intimidation”.⁷⁶ Even if a cyberattack does not fall under the scope of piracy as detailed in UNCLOS, seizing or exercising control over a ship through a remote hack would fill the parameters of an unlawful act under the SUA convention.

These forms of treaty-based quasi-universal jurisdiction, however, do not function the same way as universal jurisdiction.⁷⁷ In cases of *aut dedere aut judicare*, the scope of jurisdiction is only limited to the signatory states to the treaty in question. The states are obligated by the treaty to either prosecute criminals located on their soil, or hand them over for extradition to a state that wishes to prosecute them. While it has similar effects, the jurisdiction is not truly universal. Therefore, it does not maintain the supranational importance of a crime such as piracy, where all states have a vested interest in prosecuting perpetrators of acts of piracy.

Certain states have taken a more aggressive approach to these treaty-based forms of jurisdiction. In the case *US v. Yunis*⁷⁸, the D.C District Court held that the capture and subsequent prosecution of a Lebanese national by the Federal Bureau of Investigation was to be considered legal. Yunis had hijacked an airplane and taken hostages above the Mediterranean Sea, and even though the crimes committed did not occur on U.S. territory or airspace, the Court argued that as the crimes were widely condemned by the international community via existing international conventions, they fall under universal jurisdiction nonetheless.⁷⁹

The Court refers to the Hague⁸⁰ and Montreal Conventions⁸¹, and they both include provisions on *aut dedere aut judicare*.⁸² While Lebanon was a party to both of these treaties, the Court

⁷⁵ SUA, Art 10(1).

⁷⁶ SUA, Art 3(1)(a).

⁷⁷ Crawford, p. 454.

⁷⁸ *United States v. Yunis*, 681 F. Supp. 896.

⁷⁹ *Id.*, II.A.1.

⁸⁰ Convention for the Suppression of Unlawful Seizure of Aircraft, 1970.

⁸¹ Convention for the Suppression of Unlawful Acts against the Safety of Civil Aviation, 1971.

⁸² Hague Convention Art 7; Montreal Convention Art 7.

went further and based its jurisdiction also on the Hostages Convention⁸³, a treaty Lebanon was not a party to at the time.⁸⁴ The decision was upheld by the D.C. Circuit Court.⁸⁵

While these Conventions deal with matters regarding safety in aviation and taking of hostages, they are particularly similar to the SUA Convention in regard to the criminal nature of the conventions and the prosecute or extradite principle.⁸⁶ Thus, analogous interpretation would suggest that *Yunis* would allow similar appeals to universal jurisdiction in cases relating to crimes under the SUA Convention.

As argued by the Court, the state the perpetrator is a national of does not need to be a signatory state to the treaty either. Therefore, if *Yunis* is to be treated as a precedent, it may be possible to link the crime of piracy to universal jurisdiction, even in cases where the attack did not originate from the high seas and was not committed in furtherance of another piratical act. This would help reconcile the jurisdictional gaps MASS creates in UNCLOS' piracy provisions.

⁸³ International Convention against the Taking of Hostages, 1979.

⁸⁴ *US v. Yunis*, II.A.1; Crawford, p. 455.

⁸⁵ *United States v. Yunis*, 924 F.2d 1086.

⁸⁶ Hostages Convention Art 8; SUA Art 10(1).

5 Conclusions and future perspectives

In conclusion, Maritime Autonomous Surface Ships present a monumental shift in the field of maritime shipping. The technology has the potential to revolutionize maritime operations by making marine traffic safer and more cost-efficient. However, the modernity also challenges old assumptions that are inherent to older instruments like UNCLOS.

Nonetheless, UNCLOS holds up well under scrutiny and is mostly technology-neutral. As discussed in chapter three, the autonomous nature of MASS presents several issues regarding the terminology used in the Convention regarding matters such as the nationality of ships, duties of the flag state and duty to render assistance at sea. These regulatory ambiguities mostly stem from degrees three and four of MASS, as they entail the shift from manned ships to crewless vessels and challenge the human-centric approach taken by the Convention. None of the issues that MASS causes break the framework of UNCLOS, however, and the conflicts are easily manageable via the implementation of the future MASS Code.

Moreover, MASS raises some unique issues regarding the matter of piracy. The highly digital nature of autonomous vessels adds new attack vectors for hostile parties to take advantage of, and the *sui generis* nature of piracy presents new jurisdictional questions. The old definitions of piracy in UNCLOS that date back to the preceding conventions might need re-evaluating in the age of automation, but even in the current framework of piracy law there are safety nets in place to ensure that perpetrators of acts of piracy are held accountable.

While these regulatory gaps and ambiguities present a threat to UNCLOS' status as the framework convention in relation to maritime matters, the Constitution of the Oceans holds up well and remains an effective tool in this regard. Therefore, the answer to the research question of "Does the United Nations Convention on the Law of the Sea remain an adequate legal instrument for regulating maritime matters in the advent of Maritime Autonomous Surface Ships?" is affirmative.

What is important is that the regulatory gaps discussed in the study are addressed so that the aims set in the Preamble of UNCLOS are fulfilled, and the high seas regime can function safely and effectively. Work is under way, as the IMO's MASS Code will address these regulatory ambiguities when it becomes enforceable in the beginning of 2032. This new legal instrument will give the ambiguous terms in UNCLOS new and updated meanings through the evolutionary interpretation of the Convention.