Autonomous Navigation and International Law: Does the Principle of Meaningful Human Control Apply at Sea?

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Abstract

As it is commonly known, digital technologies and automation are revolutionizing maritime operations, offering significant economic and safety benefits by reducing human errors. Despite these advancements, the legal implications of Maritime Autonomous Surface Ships (MASS) have not been thoroughly explored by the international community. The present paper examines the intersection of autonomous maritime navigation and international law, specifically the principle of Meaningful Human Control (MHC). Accordingly, this study addresses whether autonomous maritime navigation falls under the principle of MHC, which mandates that Autonomous Weapon Systems (AWS) be under human control to be considered lawful under International Humanitarian Law (IHL). The paper traces the origins of the MHC debate within IHL, discussing its relevance and potential applicability to maritime navigation. It analyzes international maritime regulations, such as the United Nations Convention on the Law of the Sea (UNCLOS), which implicitly assume human involvement in navigation. However, the study argues that these regulations do not necessarily prohibit the use of MASS but highlight safety concerns that could arise from the lack of human operators on board. A significant focus is placed on the legal status of the shipmaster, a role traditionally charged with the control and responsibility of the vessel. The paper examines whether this role can be adapted to include remote or autonomous control, suggesting that the presence of a human controller, even if remote, might fulfil the MHC requirement. Fully autonomous ships, which operate without direct human oversight, raise questions about compliance with international law. The study acknowledges the challenges in defining the normative content of MHC for autonomous navigation, particularly as the degree of automation increases. It explores different

levels of human involvement, from remote control to full autonomy, and debates whether programmers of autonomous systems could be considered as fulfilling the role of shipmasters under international law. Concluding, the paper emphasizes the need for further exploration and debate on the application of MHC to maritime navigation. It suggests that while the current legal framework does not explicitly address the use of MASS, evolving interpretations and new regulations could potentially accommodate these advancements. The research underscores the importance of international consensus and regulatory adaptation to ensure the safe and lawful integration of autonomous technologies in maritime operations. From a methodological perspective, this study examines the chosen topic by proposing a systemic analysis of different regimes of international law (particularly IHL and LOS), aiming to distill the systemic relationship that may emerge from the combined observation of various branches of the international legal system.

Keywords

Autonomous Navigation, International Law, Meaningful Human Control, Maritime Autonomous Surface Ships (MASS), Shipmaster, UNCLOS, Maritime Safety, Automation

1. Introduction

As it is becoming increasingly clear, digital technologies are redefining the *ergonomics*[1] of traditional human behaviour. With specific regard to the maritime field, the process of digitalisation of information[2] allows the achievement of ever-increasing levels of automation, opening great opportunities for the shipping industry. Intuitively, the reduction/absence of crew on board entails a considerable reduction of costs for operators, and for consumers as well.[3] In terms

1 For the purposes of this research, the science of 'ergonomic' is defined as the discipline 'concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well being and overall system performance'. This definition is given by the International Ergonomics Association (reported in Michelle Grech, Tim Horberry and Thomas Koester, *Human Factor in the Maritime Domain* (Routledge 2008) 11).

2 In World Maritime University, *Transport 2040: Automation, Technology, Employment – The Future of Work* (World Maritime University 2019) 7, the word 'digitalisation' is defined as 'the process of introducing digital components into systems and processes thereby enhancing or replacing physical components by electronic systems'.

3 In this regard, see R Glenn Wright, *Unmanned and Autonomous Ships: an Overview of MASS* (Routledge 2020), 23–27; Lucy Carey, 'Report on BIMCO Autonomous Ships Seminar' (NUS, Centre for Maritime Law, 2019) 14 <https://law.nus.edu.sg/wp-content/uploads/2020/04/CML-R1901.pdf> accessed 30 May 2024; Yewen Gu and others, 'Autonomous Vessels: State of the Art and Potential Opportunities in Logistics' (Discussion Paper, Institutt for foretaksøkonomi, September 2019) <https://openaccess.nhh.no/nhh-xmlui/bitstream/

of maritime safety, furthermore, the innovation of autonomous control sharply reduces the risk of casualties deriving from human mistakes occurring on board the ships.*4* For these reasons, States and private entities are both investing many economic resources in developing autonomous vessels: in the last decade, the first *Maritime Autonomous Surface Ships* (MASS) have been tested and produced. The adoption of this technology is not futuristic anymore: nowadays, more than a thousand MASS navigate in the oceans.[4]

Generally speaking, the advent of digital technologies poses unprecedented juridical questions. With regard to the international legal system, in particular, it is worth noting that the protection of human rights is facing a process of evolution in order to address the menaces nested inside the digital domain.[5] Quite similarly, the exponential rise of cyber-activities is questioning many aspects related to the law of State Responsibility and the *jus ad bellum*.[6] Again, the unique characteristics of autonomous weapon systems (AWS) are inspiring an intense debate concerning their legitimacy under international humanitarian law.[7]

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handle/11250/2612601/0619.pdf?sequence=1> accessed 30 May 2024; Agamy S Kazem and Helal Hesham, 'Autonomous Surface Ships, In View of Existing Legislation, and the Need for a New Governance' (2018) 7 The International Maritime Transport & Logistics Conference 30; UNCTAD, 'Review of Maritime Transport' (2018) 90–92, <https://unctad.org/system/files/official-document/rmt2018_en.pdf> accessed 30 May 2024.

4 As it is known, this is the most frequent origin of maritime accidents. To more in this regard, see Nora Berg, Jenni Storgard and Jouni Lappalainen, 'The Impact of Ship Crews on Maritime Safety' (Centre for Maritime Studies University of Turku, 2013) 35; Grech, Horberry and Koester (n 1) 17–18.

5 Ganluigi Castelli, Severino Meregalli and Ferdinando Pennarola (eds), *The Post-Digital Enterprise* (Springer 2022); Alessandro Stiano, 'Il diritto alla privacy alla prova della sorveglianza di massa e dell'intelligence sharing: la prospettiva della Corte europea dei diritti dell'uomo' (2020) 2 Rivista di Diritto Internazionale 511; Gabriele Della Morte, *Big Data e protezione internazionale dei diritti umani. Regole e conflitti* (Editoriale Scientifica 2019); Marko Milanovic, 'Human Rights Treaties and Foreign Surveillance: Privacy in the Digital Age' (2015) 56(1) Harvard International Law Journal 81.

6 Giovanna Adinolfi, 'States' Economic Measures to Counter Cyberattacks: Disentangling Their (Il)legitimacy under International Law' (2022) 3 Rivista di Diritto Internazionale Privato e Processuale 513; Gabriele Della Morte, 'Limiti e prospettive del diritto internazionale nel cyberspazio' (2022) 1 Rivista di Diritto Internazionale 5; François Delerue, *Cyber Operations and International Law* (CUP 2020); Nicholas Tsagourias and Michael Farrell, 'Cyber Attribution: Technical and Legal Approaches and Challenges' (2020) 31(3) European Journal of International Law 941; Kriangsak Kittichaisaree, *Public International Law of Cyberspace* (Springer 2017); Russell Buchan, 'Cyberspace, Non-State Actors and the Obligation to Prevent Transboundary Harm' (2016) 21(3) Journal of Conflict and Security Law 429; Marco Roscini, *Cyber Operations and the Use of Force in International Law* (OUP 2014).

7 Diego Mauri, *Autonomous Weapons Systems and the Protection of the Human Person* (Elgar 2022); Daniele Amoroso, *Autonomous Weapons Systems and International Law. A Study on Human-Machine Interactions in Ethically and Legally Sensitive Domains* (Editoriale Scientifica 2020); Wolff Heintsche von Heinegg and Robert Frau, Singer (eds), *Dehumanization of Warfare* (Springer 2018).

In this scenario, even the law of the sea is challenged by digitalisation and autonomous control: since ships may now be (fully or partially) commanded without human involvement in the decision-making loop, the international regulation on the activity of navigation must face the peculiar challenges brought by this new factual reality.[8]

That being said, however, it is worth noting that to date the legal impact of MASS has not been deeply considered by the international community.[9] So far, the very first studies in this regard do not have the ambition to address this topic from a general perspective: quite on the opposite, the current debate is usually limited to tackling very specific and 'hyper-technical' issues, such as, for example, the compliance of autonomous ships with safety requirements provided by international treaty law.[10] The poor size and consideration of a holistic debate on MASS are even more critical when compared to other fields of international law (such as those mentioned above), where the legal impact of digitization has already sparked wide-ranging and more comprehensive reflections.

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8 For a more detailed introductive study about the rise of autonomous ships and its potential challenges in International Law, this author refers to his previous scripts in this field, which, while dealing with the same technical innovation, address different legal aspects of the topic. See Daniele Mandrioli, 'The Rise of Autonomous Ships: Towards an Evolutionary Interpretation of the IMO Treaties on Safety of Navigation?' (2022) 1 Il Diritto Marittimo 159, 163–164; Daniele Mandrioli, 'The International Duty to Assist People in Distress at Sea: No Place for People on Board' (2020) 26 Humanidades & Tecnologia 77, 79–82.

9 For sake of completeness, it must be specified that a primordial debate on the legal impact of MASS has been advanced by the International Maritime organization (IMO). In particular, the IMO has published two primordial, not binding analysis, on this subject (MSC.1/Circ.1638, Outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS), 3 June 2021; LEG.1/Circ.11, *Outcome of the Regulatory Scoping Exercise and Gap Analysis of Conventions Emanating from the Legal Committee with respect to Maritime Autonomous Surface Ships (MASS)*, 15 December 2021). These works reflect the first efforts of the international community concerning the topic here object of analysis. However, what lacks today is the establishment of a broad legal debate on autonomous navigation that goes beyond the mere maritime affairs, thus taken into account all the issue of the law of the sea adopting a holistic perspective.

10 In this regard, see, among others: Mika Viljanen, 'How to Ensure Safe Navigation: Navigation Safety Regulation in MASS' in Herausgegeben Von, Tafsir Matin Johansson, Jonatan Echebarria Fernández, Dimitrios Dalaklis, Aspasia Pastra, and Jon A. Skinner (eds), *Autonomous Vessels in Maritime Affairs* (Springer 2023); Henrik Ringbom, 'Developments, Challenges and Prospects at the IMO' in Henrik Ringbom, Erik RØsæg and Trond Solvang (eds), *Autonomous Ships and the Law* (Routledge 2020); Aldo Chircop, 'Maritime Autonomous Surface Ships in International Law: New Challenges for the Regulation of International Navigation and Shipping' in Myron H Nordquist, John Norton Moore and Ronán Long (eds) *Cooperation and Engagement in the Asia-Pacific Region* (Brill 2019) 251; Robert Veal and Henrik Ringbom, 'Unmanned Ships and the International Regulatory Framework' (2017) 23(2) Journal of International Maritime Law 100; Eric Van Hooydonk, 'The Law of Unmanned Merchant Shipping – An Exploration' (2014) 20 Journal of International Maritime Law 403.

In particular, a thought-provoking debate has arisen for what concerns the presumed emergence of a new international rule of humanitarian law – the so-called *principle of Meaningful Human Control* (MHC) – pursuant to which the use of AWS would be legitimate only if these military instruments are 'meaningfully' controlled by human operators.[11] In the past decade, the international community largely discussed the progressive development of the *ius in bello* regime in this respect, thus inspiring large-scale reflections on the intertwined relations occurring between digitization, human control, human dignity and international law.[12]

Recognizing the increasing consideration that the already mentioned topic has gained over the years, the present research aims at analogically transposing this debate into the law of the sea. Precisely, this work addresses the question of whether the activity of maritime navigation is covered by the principle of MHC and, eventually, how this rule impacts the ongoing process of digitalisation of the shipping field. From this perspective, the proposed analysis will start by briefly reconstructing the origins of the debate in its context of belonging, ie the regime of international humanitarian law (section 2). Subsequently, it will address the central issue of this work, concerning the hypothesized validity of the principle of MHC in the law of the sea. Methodologically wise, the research will first provide a systemic analysis of the most relevant international provisions implying human involvement in navigation, in order to get some knowledge about the (eventual) validity of MHC at sea (section 3). In this respect, the international rules dealing with the figure of the shipmaster, ie the individual in charge of the activity of navigation, will cover a role of paramount importance (section 4). The present study will then attempt to investigate the definition of the normative content of MHC at sea, with the aim to better understand whether and how the use of MASS complies with international law (section 5).

Before starting the proposed analysis, a last clarification is necessary. When referring to 'MASS', the present research avails of the definition advanced in this field by the International Maritime Organization (IMO). In the preliminary

11 Among many others, see Mauri (n 7); ICRC, 'ICRC Position Paper on Autonomous Weapon Systems' (2021) <www.icrc.org/en/document/icrc-position-autonomous-weapon-systems> accessed 30 May 2024; Daniele Amoroso and Guglielmo Tamburini, 'Autonomous Weapons Systems and Meaningful Human Control: Ethical and Legal Issues' (2020) 1 Current Robotic Reports 187; Marta Bo, 'Meaningful Human Control over Autonomous Weapon Systems: An (International) Criminal Law Account' (*OpinioJuris*, 2020) <https://opiniojuris.org/2020/12/18/meaningful-human-control-over-autonomous-weapon-systems-an-international-criminal-law-account/> accessed 30 May 2024; Thompson Chengeta, 'Defining the Emerging Notion of "Meaningful Human Control" in Weapon Systems' (2017) 49 New York University International Law and Politics 833; Rebecca Crotoof, '*A Meaningful Human Floor for "Meaningful Human Control"*' (2016) 30 International and Comparative Law Journal 53.

12 Amoroso (n 7) 4.

works of the Organization, the acronym 'MASS' has referred to any ship, which, '[...] to a varying degree, can operate independently of human interaction'.[13] As recognized by the IMO itself, this new technology has a broad nature; potentially, many different 'levels' of automation could be included inside this definition. For sake of clarity, the Organization has identified four sub-categories of MASS, better specifying the types of autonomous ships existing today:

> 'Degree one: Ship with automated processes and decision support: Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control;
>
> Degree two: Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions;
>
> Degree three: Remotely controlled ship without seafarers on board: The ship is controlled and operated from another location. There are no seafarers on board;
> Degree four: Fully autonomous ship: The operating system of the ship is able to make decisions and determine actions by itself'.[14]

In light of the above, the present research will limitedly consider the last two levels of automation – namely *remotely-controlled* and *fully autonomous MASS* –, whose navigation inspires critical thoughts concerning their presumed incompatibility with the principle of MHC, here specific object of analysis.

2. The concept of MHC in international humanitarian law

'The exercise of control over the use of weapons, and, concomitant responsibility and accountability for consequences are fundamental to the governance of the use of force and to the protection of the human person'.[15] Ten years ago, the NGO 'Article 36' has thus contributed to the debate on the legitimacy of AWS under international law. From that moment on, States, international organizations and scholars have largely discussed whether the use of AWS, above and beyond their compliance with the already-established principles of

13 IMO Docs. MSC 98/23 of 28 June 2017.

14 IMO RSE, 3–4. For a more detailed analysis about this classification, see Henrik Ringbom and Felix Collin, 'Terminology and Concepts' in Henrik Ringbom, Erik RØsæg and Trond Solvang (eds), *Autonomous Ships and the Law* (Routledge 2020).

15 Article 36, 'Structuring Debate on Autonomous Weapon Systems' (2013) <https://article36.org/wp-content/uploads/2013/11/Autonomous-weapons-memo-for-CCW.pdf> accessed 30 May 2024.

humanitarian law,[16] should be considered 'a malum per se'.[17] In a nutshell, the international community has been called to understand if the absence of human involvement in the decision-making loop introduces not only ethical concerns,[18] but also legal ones, therefore prohibiting the avail of AWS by the simple fact of not complying with the so-called principle of MHC.

This innovative line of research has been set up on two cumulative steps of analysis. First, to ascertain the binding nature of this requirement it is necessary to recognize its international legal source;[19] second, the eventual genesis of this rule imposes to reconstruct its normative content, in order to well define what 'meaningful human control' properly means when dealing with AWS.

As regards the first issue, scholars are quite divided upon which source of international law should be the normative ground of MHC. In the contextual absence of any conventional provision strictly dealing with AWS, some authors are of the view that a new customary rule is progressively emerging in the field of humanitarian law.[20] Accordingly, albeit it still lacks consistent State practice, the rise of such a popular debate, taken together with the lack of clear opposition from any national Government, could highlight the emergence of *opinio iuris* in this respect.[21] Even the analysis of soft law instruments should be seen as evidence that the process of consolidation of a new rule of general international law, while not concluded, has at least already started.[22]

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16 Just to provide some examples, we refer to the renowned international principles of distinction and proportionality. To more in this regard, see, *ex multis*: Mauri (n 7) 118–175; Elliot Winter, 'The Compatibility of Autonomous Weapons with the Principle of Distinction in the Law of Armed Conflict' (2020) 69(4) The International & Comparative Law Quarterly 845; Thompson Chengeta, 'Measuring Autonomous Weapon Systems against International Humanitarian Law Rules' (2016) 5(1) Journal of Law and Cyber Warfare 63, 66; Jeroen van den Boogard, 'Proportionality and Autonomous Weapons Systems' (2015) 6(2) Journal of International Humanitarian Legal Studies 247.

17 Amoroso (n 7).

18 For a philosophical analysis of this issue, see Filippo Santoni de Sio and Jeroen van den Hoven, 'Meaningful Human Control over Autonomous Systems: A Philosophical Account' (2018) 5 Frontiers in Robotics and AI 1.

19 This paper refers to the sources of international law as listed in art 38(1) of the Statute of the International Court of Justice, ie international treaties, customary rules and general principles recognized by civilized Nations.

20 See Peter Asaro, '*Jus Nascendi,* Robotic Weapons and the Martens Clause' in Rayan Calo, A Michael Froomkin and Ian Kerr (eds), *Robot Law* (Elgar 2016); Kevin Neslage, 'Does "Meaningful Human Control" Have Potential for the Regulation of Autonomous Weapon Systems' (2016) 6 University of Miami National Security and Armed Conflict Law Review 151.

21 Crotoof (n 11) 53.

22 For example, the General Comment No. 3, of 2015 of the African Commission on Human and Peoples' Rights, when saying that 'Any machine autonomy in the selection of human targets or the use of force should be subject to meaningful human control', may be seen as another (timid) sign of the evolving trend that is now pervading International Humanitarian

Contrary to this position, other scholars[23] believe that, to demonstrate the binding force of the MHC requirement, it is not strictly necessary to reconstruct its customary nature; thanks to the systemic role covered by the '*Martens Clause*' in case of *vacatio legis*,[24] even mere considerations of humanity, like those emerging from the use of AWS, may acquire a certain legal relevance. As it is known, indeed, many international humanitarian law treaties[25] explicitly provide that, in the lack of specific provisions, international legal subjects must anyway ensure that civilians and combatants shall always remain under '[...] the protection and authority of the principles of international law derived from established custom, from the *principles of humanity* and from the dictates of public conscience'.[26] As also noted by the International Court of Justice, this peculiar mechanism not only guarantees the applicability of human rights law in times of war, but it also allows the *ius in bello* regime to 'keep up' with the novelties brought by the technological military development.[27]

Law, AfCommHPR, 'General Comment No. 3 on the African Charter on Human and Peoples' Rights: The Right to Life (Article 4)' (adopted in November 2015) (General Comment No 3).

23 Among many others, see Amoroso (n 7), 161–214; Tyler Evans, 'At War with Robots: Autonomous Weapon Systems and the Martens Clause' (2013) 41(3) Hofstra Law Review 697; Asaro (n 20).

24 For a deep analysis of the peculiar relevance of the 'Martens Clause' in international law, *ex multis*, see: Antonio Cassese, 'The Martens Clause: Half a Loaf or Simply Pie in the Sky?' (2000) 11 European Journal of International Law 187, 188; Rupert Ticehurst, 'The Martens Clause and the Laws of Armed Conflict' (1997) International Review of the Red Cross 125; Michael Salter, 'Reinterpreting Competing Interpretations of the Scope and Potential of the Martens Clause' (2012) 17 Journal of Conflict and Security Law 403; Shigeki Miyazaki, 'The Martens Clause and International Humanitarian Law' in Christophe Swinarski (ed), *Studies and Essays on International Humanitarian Law and Red Cross Principles in Honour of Jean Pictet* (Martinus Nijhoff 1984); Theodor Meron, 'The Martens Clause, Principles of Humanity and Dictates of Public Conscience' (2000) 94(1) American Journal of International Law 78; Vitaliy Ivalenko, 'The origins, causes and enduring significance of the Martens Clause: A view from Russia' (2022) 104 International Review of the Red Cross 1708.

25 As it is known, the first international treaty in which this clause was inserted was the 1899 Hague Convention (II). From that moment on, the text of many other conventions provided a similar wording. Among other, see the Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts, 8 June 1977 (AP I); the Amelioration of the Condition of the Wounded and Sick in Armed Forces in the Field, 12 August 1949 (First Geneva Convention); the Convention (III) Relative to the Treatment of Prisoners of War, 12 August 1949 (Third Geneva Convention); the Convention (IV) Relative to the Protection of Civilian Persons in Time of War, 12 August 1949 (Fourth Geneva Convention), and the Convention on Certain Conventional Weapons (CCW). The recognized fortune of high consideration of this clause makes scholars agree on its customary nature.

26 Preamble of the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which May Be Deemed to Be Excessively Injurious or to Have Indiscriminate Effects, 10 April 1981 (CCW) (emphasis added).

27 *Legality of the Threat or Use of Nuclear Weapons* (Advisory Opinion) [1996] ICJ Rep 226, para 78.

From this perspective, the fact that the use of AWS potentially excludes human involvement in military decisions may be seen as a '*dehumanization*' of the targeted people: accordingly, 'should computers be delegated the power to take targeting decisions [...], human beings at the receiving end of force would be reduced to the "zeros and ones" of a machine code'.[28] If one agrees with this statement, the possibility to invoke the Martens Clause in this regard would not be unreasonable; those ethical concerns that instinctively arise when thinking about AWS would be therefore elevated from a just moral ground to a normative one.

Above and beyond this preliminary issue, there remains considerable uncertainty on the normative content of the principle of MHC. In this respect, we are witnessing a complete lack of consensus within the international community. Just to provide some examples of the many different points of view existing on this matter,[29] the NGO Article 36 has stressed the necessity of always keeping a '[t]imely human judgement', in order to guarantee a human 'timely intervention' over autonomous decisions.[30] Similarly, but not identically, some scholars have proposed another 'prudential' solution, according to which high levels of human control should always be ensured ('Level 1: a human engages with and selects targets, and initiates any attack; [...] Level 2 a program suggests alternative targets and a human chooses which to attack').[31] Quite contrary to this background, instead, other scholars believe that the MHC requirement is fulfilled even in the absence of a direct involvement of a human operator in a particular engagement: if the steps of the targeting process are accurately followed, no issues would occur in this respect.[32]

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28 Amoroso (n 7) 181.

29 The following examples limitedly deal with doctrinal opinions stressed by scholars and NGOs. Regarding the debate among States on this issue, see the discussion of the Parties to the Convention on Certain Conventional Weapons (CCW) in November 2019, stimulated by the 'Proposal for a Mandate to Negotiate a Legally-Binding Instrument That Addresses the Legal, Humanitarian and Ethical Concerns Posed by Emerging Technologies in the Area of Lethal Autonomous Weapons Systems (LAWS)' (proposed by the States of Austria, Brazil and Chile).

30 Article 36, 'Key Elements of Meaningful Human Control' (April 2013) <www.article36.org/wp-content/uploads/2016/04/MHC-2016-FINAL.pdf> accessed 30 May 2024, 1.

31 Amoroso and Tamburini (n 11) 261: 'The default policy would require that higher levels of human control (L1 and L2) should be applied, unless the given autonomous weapons system is an exception that the international community of states has agreed to handle by means of specific bridge rules allowing for lower levels of human control'.

32 Mark Roorda, 'NATO's Targeting Process: Ensuring Human Control over (and Lawful Use of) "Autonomous" Weapons'" in Andrew P Williams and Paul D Scharre (eds), *Autonomous Systems: Issues for Defence Policymakers* (NATO Communications and Information Agency, 2016)

As it emerges from the above cursory overview, the 'meaningfulness' of human control over AWS is a 'grey area [...], full of complicated situations'.[33] The uncertainty surrounding its legal value, as well as its cryptic normative content, make this issue particularly unclear and indefinite. At the same time, however, it is precisely this 'inherent imprecision'[34] that has contributed to sparking this debate within the international community. As recalled in scholarship,[35] indeed, in the world of international relations it is quite usual that States start facing a given topic when attracted by a 'progressive but vague statement'[36] around which more concrete normative evolution may take place over time. From this perspective, the reported discussions are contributing to catalysing States' attention to the many implications arising from the growing use of AWS in international humanitarian law.

3. Navigation, MHC and the law of the sea

Digital and automation technologies are not a prerogative of what occurs on dry land; on the very opposite, they affect the performance of almost every human activity, including maritime navigation. Accordingly, what has been reported in the previous pages inspires the specular question concerning the eventual existence of the principle of MHC (even) in the law of the sea: the following section aims precisely to investigate this issue.

The very first thing to remark here is that the international community has not already paid specific attention to the proposed topic. Unlike the above-mentioned debate on AWS, indeed, no official declaration of any State or international organization can be reported in this respect.[37] This fact has an important legal weight, since it highlights a certain lack of interest of States in dealing with this theme: the absence of care of States regarding MHC at sea theoretically

33 Crotoof, (n 11) 56; Jonathan Kwik, "A Practicable Operationalisation of Meaningful Human Control' (2022) 11(43) Laws 1, 3.

34 Crotoof (n 11) 60.

35 Beyond the position of Rebecca Crotoof, see also Mauri (n 7) 243: 'the continuing recurrence of MHC in the debate may be helpful in that it stresses the need for operationalizing the concept: this may advance the understanding of characteristics and implications of AWS from a technical standpoint, and then foster the debate within the CCW framework'.

36 Crotoof (n 11) 60.

37 Of course, this does not mean that the theme of autonomous navigation is not addressed by the international community. Beyond what already reported for what concerns the IMO's effort in dealing with the regulation of the use of MASS, even States are wondering whether this new technology impacts on the law of the sea. In this regard, see the survey proposed to States by Comité Maritime International (CMI) in this respect (the responses of States to the questionnaire organized by the CMI are available at <https://comitemaritime.org/work/mass/> accessed 30 May 2024). However, in these occasions any State or international organization has specifically talked about the emergence of the principle of MHC in the law of the sea.

leads to the conclusion that no customary norm is progressively developing in this field.[38]

Nevertheless, if this argument seems to preclude the possibility to advance the hypothesis of the emergence of a *new* international rule, this does not say anything about the eventual *pre-existence* of the MHC requirement in the law of the sea. Similarly to what was noted when dealing with the role played by the Martens clause in humanitarian law,[39] it may not be *a priori* excluded that even the law of the sea already provides one or more provisions, whose (evolutionary)[40] interpretation could demonstrate the implicit validity of MHC in the marine domain.

When looking at the international rules on navigation currently in force, what immediately emerges is that many of them imply and presuppose a certain human involvement in navigation. Just to provide some examples, art. 94 of UNCLOS asks States '[...] to take measures for ships flying its flag as are necessary to ensure safety at sea with regard [...] to: the *manning of ships*, labour conditions and the training of *crews* [...]'.[41] Again, reg. V/14.1 of the IMO Convention for the Safety of Life at Sea (SOLAS)[42] declares that 'all ships shall be sufficiently and efficiently *manned*'. Furthermore, rules 2 and 8 of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGs)[43] impose on seafarers to navigate 'with due regard to the observance of *good*

38 This conclusion is based on the definition of 'progressive development' that emerges from the UNGA 'Fifth Report on Identification of Customary International Law by Michael Wood Special Rapporteur' (14 March 2018) A/CN.4/717, 8: 'the relevance of practice of international organizations to the formation and identification of customary international law; and the existence of rules of particular customary international law applying bilaterally and/or among States linked by a common cause, interest or activity other than their geographical position'. Manifestly, the absence of any debate among States and International Organizations precludes the possibility to affirm the existence of any progressive development of international law.

39 See s 2 of the present paper.

40 Concerning the concept of 'evolutionary interpretation' in International Law, see Eirik Bjorge, *The Evolutionary Interpretation of Treaties* (OUP 2014); Paolo Palchetti, 'Interpreting "Generic Terms": Between Respect for the Parties' Original Intention and the Identification of the Ordinary Meaning' in Nerina Boschiero and others, *International Courts and the Development of International Law* (Springer 2013). With specific regard to the evolutionary interpretation of law of the sea rules, see Richard Barnes, 'The Continuing Vitality of UNCLOS' in Jill Barrett and Richard Barnes (eds), *The United Nations Convention on the Law of the Sea: A Living Instrument* (British Institute of International and Comparative Law 2016) 459.

41 United Nations Convention on the Law of the Sea (adopted 10 December 1982, entered into force 16 November 1994) 1833 UNTS 3 (UNCLOS) art 94(3) (b) (emphasis added).

42 International Convention for the Safety of Life at Sea (adopted 1 November 1974, entered into force 25 May 1980) 1184 UNTS 2 (SOLAS), as amended. The SOLAS Convention currently has 165 States Parties, the combined merchant fleets of which constitute approximately 99.04% of the gross tonnage of the world's merchant fleet.

43 Convention on the International Regulations for Preventing Collisions at Sea (London, 20 October 1972, in force 15 July 1977) 1056 UNTS 16 (COLREGs), as amended. The

seamanship'. The same treaty also provides that 'Every vessel shall at all times maintain a proper look-out by *sight and hearing* [...]'.[44]

It is a truism to say that, before the advent of digital and automation technologies, the use of ships has always implied the physical attendance of human operators on board. Since these rules were drafted decades ago – when States could not have been fully aware of the rise of this revolution – it is self-evident that they are intrinsically founded on a traditional idea of navigation. Of course, their 'old-fashioned' nature poses some regulatory barriers to the use of MASS:[45] when technological progress innovates the factual modalities of this human activity, therefore, the existing provisions risk not being completely effective anymore.[46]

That being said, however, one thing is acknowledging the presence of international regulatory barriers to the use of MASS, another thing is distilling from this the principle of MHC, pursuant to which autonomous navigation should be considered unlawful *per se*. As already noted by scholars who addressed the 'twin' issue of AWS: 'to affirm that MHC is a legal requirement simply because technologies that have existed until now cannot do without human intervention would be an *apodictic argument*: it postulates precisely what it is expected to demonstrate'.[47]

Accordingly, it sounds reasonable to conclude that the international provisions here analysed do not prohibit the use autonomous ships as such. When interpreting the above-mentioned rules in light of their object and purpose,[48] indeed, it emerges that their *ratio legis* is to ensure the *safety of navigation*:[49] the participation of the human element is perceived as a necessary requirement for

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COLREGs Convention currently has 160 States Parties, the combined merchant fleets of which constitute approximately 99.03% of the gross tonnage of the world's merchant fleet.

44 ibid r 5. To more on this specific debate, see Mandrioli, 'The Rise of Autonomous Ships' (n 8) 174–176.

45 These regulatory barriers have been already advanced by scholars. Among others, see in this regard two collected volumes addressing many facets of this phenomenon: Tafsir Matin Johansson and others (eds), *Autonomous Vessels in Maritime Affairs: law and governance implications* (Springer 2023); Henrik Ringbom, 'Developments, Challenges and Prospects at the IMO' in Henrik Ringbom, Erik RØsæg and Trond Solvang (eds), *Autonomous Ships and the Law* (Routledge 2020).

46 Thanasis Karlis, 'Maritime Law Issues Related to the Operation of Unmanned Autonomous Cargo Ships' (2018) 17(1) WMU Journal of Maritime Affairs 119, 126.

47 Mauri (n 7) 43 (emphasis added).

48 The proposed interpretation is founded on the hermeneutical criteria codified by art 31(1) (a) of the Vienna Convention on the Law of the Treaties (adopted 23 May 1969, entered into force 27 January 1980) 1115 UNTS 331.

49 Emmanuel Roucounas, *Facteurs privés et droit international public* (2002) 299 Recueil des Cours 9 183–84; David Anderson, 'The Roles of Flag States, Port States, Coastal States and International Organisations in the Enforcement of International Rules and Standards Governing the Safety of Navigation and the Prevention of Pollution from Ships under the UN Convention on the Law of the Sea and Other International Agreements' (1998) 2

protecting this specific interest. Therefore, the (complete or partial) absence of human operators in autonomous navigation seems to be not objectionable *per se*, but only because the use of MASS might not guarantee the same level of safety secured by traditional manned ships.[50]

To better clarify this passage, an analogy may be advanced with the regulation of urban transport. In sum, it seems that the inconsistencies between autonomous navigation and the observed international norms are quite similar to those posed by new means of locomotion to the national rules of the road: albeit some regulatory barriers may certainly arise, this does not necessarily mean that innovative vehicles are illicit on their own. Of course, since new technologies change 'the way of doing things',[51] they surely cause more or less serious legal concerns. However, to prove their unlawfulness 'as such', it should be demonstrated that their characterizing features are in breach of one or more norms of that given legal system. In the case of autonomous ships and international law, the search of this prohibitive rule is precisely the object of the present research, i.e. the principle of MHC and its alleged validity at sea. For the reasons mentioned before, however, it seems apodiptic[52] and not entirely convincing to affirm its pre-existence through the systemic interpretation of the above analysed rules on safety of navigation.

4. The legal status of the shipmaster and his/her role of 'human controller'

The preliminary (and negative) conclusions that have been reached so far do not exhaust the range of possible solutions to find a normative floor for the principle of MHC at sea. Accordingly, the following pages will focus on another set of rules belonging to the law of the sea – ie the international provisions strictly dealing with the *shipmaster* – in order to understand if they may play a role with regard to the addressed topic.

Singapore Journal of International and Comparative Law 557; Philippe Boisson, *Safety at Sea: Policies, Regulations & International Law* (Bureau Veritas 1999) 137.

50 This issue (in particular with regard to the SOLAS Convention) is analyzed by Joel Coito, 'Maritime Autonomous Surface Ships. New Possibilities – and Challenges – in Ocean Law and Policy' (2021) 97 International Law Studies 259; Franck Smeele, 'Switching of Regulatory Requirements: Flag State Exemptions as a Tool to Facilitate Experiments with Highly Automated Vessels and their Operational Implementation' in Henrik Ringbom, Erik RØsæg and Trond Solvang (eds), *Autonomous Ships and the Law* (Routledge 2020); Natalie Klein and others, 'Maritime Autonomous Vehicles: New Frontiers in the Law of the Sea' (2020) 69(3) International and Comparative Law Quarterly 719, 728–29; Veal and Ringbom (n 10).

51 Ursula Franklin, *The Real World of Technology Revised Edition*, (Toronto: House Of Anansi Press 2004) 9.

52 See n 49 of this paper.

Although international law does not provide a general definition of 'shipmaster',[53] it is replete with norms dealing with this maritime figure. Looking at the UNCLOS, for example, art. 94,4 (b) obliges flag States to make sure that: 'each ship is in *the charge of a master* and officers'.[54] This is not the unique provision of the 'Constitution of Oceans'[55] referring to this figure; accordingly, the word 'master' is also included in arts. 27 and 97, dealing with the allocation of criminal jurisdiction on board ships; in art 98, regulating the flag and coastal States' duties of assistance to people in distress at sea[56] and, finally, in art 211, regarding pollution from ships. For what concerns this last-mentioned topic, then, even the International Convention for the Prevention of Pollution from Ships (MARPOL)[57] gives the shipmaster a fundamental role in the performance of documentary and reporting activities.[58]

Broadening the outlook, the SOLAS sets several rules concerning the master's duties. Accordingly, 'The master shall be supplied with such information satisfactory to the Administration as is necessary to enable him by rapid and simple processes to obtain accurate guidance as to the stability of the ship under varying conditions of service'.[59] Again, the master has to supervise the use of survival crafts,[60] the functioning of the ship reporting system[61] and visibility from the bridge.[62] Moreover, the master shall communicate danger messages to shore operators[63] and assist people in distress at sea.[64] In addition, rule 2 of the COLREGs refers to the 'master' when dealing with the responsibility for

53 Except for Reg. I (c) of the International Convention on Standards of Training Convention (London, 7 July 1978, in force 11 July 1984) 1361 UNTS 2 (STCW), as amended, pursuant to which: '*Master* means the person having command of a ship'.

54 UNCLOS (n 42), art 94(4) (b) (emphasis added).

55 Remarks by T.B. (Tommy) Koh, President of the Third United Nations Conference on the Law of the Sea (1982).

56 About master's duties to render assistance to people in distress at sea, in addition to the above-mentioned reg V/33(a), also art 10 of the International Convention on Salvage (1989) provides that: 'Every master is bound, so far as he can do so without serious danger to his vessel, and persons thereon, to render assistance to any person in danger of being lost at sea'. International Convention on Salvage (adopted 28 April 1989, entered into force 14 July 1996) 1953 UNTS 193, art 10.

57 International Convention for the Prevention of Pollution from Ships (adopted 2 November 1973, entered into force 2 October 1983) 1340 UNTS 61 (MARPOL). To date, MARPOL has 162 States Parties, the combined merchant fleets of which constitute approximately 99% of the gross tonnage of the world's merchant fleet.

58 See Simon Baughen, 'Who is the master now?', in Baris Soyer and Andrew Tettenborn (eds), *New Technologies, Artificial Intelligence and Shipping Law in the 21st Century* (Routledge 2019).

59 SOLAS (n 43), reg II-1/5-1.

60 ibid reg III/10.

61 ibid reg V/11, 7.

62 ibid reg V/22.

63 ibid reg V/31.

64 ibid regs V/33, V/34-1.

the control and circulation of ships.[65] Then, the Maritime Labour Convention (MLC)[66] deals with the master's role in the regulation of the labour conditions of his/her crew.[67] Finally, the International Convention on Civil Liability for Bunker Oil Pollution Damage (CLC)[68] and the Convention on Limitation of Liability for Maritime Claims (LLMC)[69]

The joint reading of all these provisions offers some food for thought. In the first place, the presence of the master turns out to be a necessary legal condition for international navigation. Second, the above mentioned rules are based on the understanding that the master is the *human in charge of the ship*[70]. Precisely, the common element binding these international norms is the recognition of the master as the '*magister navis*' of the ship:[71] he/she is the person who exercises the final decision-making power in the course of navigation and who bears the responsibilities coming from it.[72] This conclusion is pacifically supported by doctrine, according to which the master is the: '*natural person* who is responsible for a vessel and all things and persons in it and is responsible for enforcing the maritime laws of the flag state'.[73]

In light of the above, it is now asked whether the international legal status of the shipmaster is somehow relevant to the present research. Unlike the regulatory provisions observed in the previous section,[74] the norms dealing with the master specifically deal with the *control of the activity of navigation*, which, as now observed, shall be necessarily *under the supervision of an individual*. At a first glance, therefore, these rules look particularly promising to demonstrate the validity of the MHC requirement at sea.

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65 COLREGs (n 44) r 2.

66 Maritime Labour Convention (adopted on 23 February 2006, entered into force 20 August 2013) 2952 UNTS. To date, the treaty has been signed by 91 States, representing 91% of the world's gross tonnage.

67 ibid standard A2(1)(d).

68 More precisely, see International Convention on Civil Liability for Bunker Oil Pollution Damage (adopted 23 March 2001, entered into force 21 November 2008) 973 UNTS 3, art III(4).

69 See Convention on limitation of liability for maritime claims (adopted 19 November 1976, entered into force 1 December 1986) 1456 UNTS 221, art 1(4).

70 From this perspective, it is of emblematic value what provided in art. 94(4) (b) of UNCLOS (n 42), according to which: 'each ship is in *the charge of a master* […]' (emphasis added).

71 This quotation derives from the ancient reflections of the Latin jurist Ulpianus, as reported in the Justinian Digest (D. de exercitoria actione, XIV,1).

72 Boisson (n 50) 307.

73 John Cartner, Richard Fiske and Tara Leiter, *The International Law of the Shipmaster* (Taylor Francis 2009), 86 (emphasis added). This position has been more recently confirmed by Goran Vojkovic and Melita Milenkovic, 'Autonomous Ships and Legal Authorities of the Ship Master' (2020) 8(2) Case Studies in Transport Policy 334; Johan Schelin, 'Manning of Unmanned Ships' in Henrik Ringbom, Erik RØsæg and Trond Solvang (eds), *Autonomous Ships and the Law* (Routledge 2020); Baughen (n 59).

74 See s 3 of the present paper.

That being said, however, it cannot be ignored that analogous critics to those that have been reported before (concerning the rules on safety of navigation) should be potentially advanced also in this case. In fact, one may say that the use of MASS without a shipmaster poses just mere 'regulatory barriers', certainly problematic, but not enough to infer from them the existence of the principle of MHC at sea.

Contrary to this potential conclusion, however, it is here sustained that some differences occur between the international rules on safety of navigation and those dealing with the shipmaster. Accordingly, while the former conceives the human element just as 'an instrument' to ensure safe navigation, the objective of the latter provisions is precisely to *give an individual the control of the ship*. The slight difference lies in the fact that, for the first set of rules, the presence of the human element is not necessarily the unique way for pursuing their rationale of ensuring safety of navigation: potentially, new technologies may guarantee the same (or better) results even without a crew on board.[75] The same cannot be said for what concerns the rules regarding the shipmaster; since their aim is to ensure a proper 'human control' over the activity of navigation, the eventual absence of an individual in charge of the ship appears to be something more rather than just a 'regulatory barrier'.

As a further demonstration of this, it must be stressed (once again) that the peculiarity of the legal status of the shipmaster is his/her *responsibility*[76] over the activity of navigation. Generally speaking, it is pacific that the capacity of being accountable for a certain behaviour is a prerogative of human beings, regardless of the adopted technology. From this perspective, it is true that automation and digital technologies are posing unprecedented dilemmas concerning the idea of human responsibility.[77] Above and beyond revolutionary doctrinal thoughts –

75 As observed at the beginning of this work, the use of MASS is properly aimed at ensuring safety of navigation. In this regard, see note 3 of the present paper.

76 With the use of the word 'responsibility', it is not intention of this author to open to the debate on the 'legal responsibility of the shipmaster in international law' (to more in this sense, in particular with regard to shipmaster's duties on assistance to people in distress at sea, see Irini Papanicolopulu, 'The Historical Origins of the Duty to Save Life at Sea in International Law' (2022) 24(2) Journal of the History of International Law 149; Felicy Attard, *The Duty of the Shipmaster to Render Assistance at Sea under International Law* (Brill 2020); Massimo Starita, 'Il dovere di soccorso in mare e il "diritto di obbedire al diritto" (internazionale) del comandante della nave privata' (2019) 1 Diritti Umani e Diritto Internazionale 5). More limitedly, it is here intended to stress the prerogative of human beings of being accountable for a certain happening.

77 In this regard, Italian authors have highlighted the deformations of the categories of thoughts 'time' and 'space' in observing the behaviours of individuals. See Gabriele Della Morte, 'Limiti e prospettive del diritto internazionale nel cyberspazio' (2022) 105(1) Rivista di Diritto Internazionale 5.

which even propose the direct responsibility of artificially intelligent machines[78] – humans remain the subjects accountable for the use of technology, and not vice versa. For this reason, the full replacement of human control with artificial intelligence systems appears to be highly problematic with regard to the duty upon States to ensure the presence of a master in charge of navigation.

In conclusion, the international rules prescribing the legal status of the shipmaster result in being the most promising normative ground for invoking the validity of the principle here under analysis. In light of the above, it seems not absurd to advance that the current configuration of the law of the sea already prescribes that navigation shall be under MHC.

5. The difficult attempt to qualify the normative content of MHC for autonomous navigation

The conducted analysis did not address all the potential issues related to the topic here under study. As noted in section 2,[79] indeed, one thing is investigating the formal legal basis of MHC, and another one is comprehending its related normative content.

As anticipated in the introduction of this work, the revolution brought by MASS may assume many shapes and forms depending on the achieved level of automation.[80] Precisely, while the use of MASS of the third level is still under the control of human operators – despite they work from a remote location –, the same cannot be said in the case of MASS belonging to the fourth class of automation; by definition, these ships are able to 'make decisions and determine actions by [themselves]'.[81]

For this very reason, once endorsed the thesis of the presumed validity of this principle at sea – by referring to the rules dealing with the shipmaster's international duties –, the following pages aim at reconstructing the scope of application of this (alleged) normative prescription. Answering to this issue is of the utmost importance: depending on the different meanings potentially assigned to this locution, indeed, the use of MASS belonging to different degrees of automation may be considered internationally lawful or not.

From a theoretical perspective, if one conceives as 'meaningful' just the human control that is directly realized *on board* the ship, the use of both the MASS

78 Virginia Dignum, 'Responsibility and Artificial Intelligence' in Markus D Dubber, Frank Pasquale, Sunit Das (eds), *Oxford Handbook of Ethics of AI* (OUP 2020), 215; Bartosz Brozek and Marek Jakubiec, 'On the Legal Responsibility of Autonomous Machines' (2017) 25 Artificial Intelligence and the Law 293.

79 See s 2 of this paper.

80 In particular, see n 13 of this paper.

81 MSC.1/Circ.1638, 'Outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS)' (3 June 2021) 3–4.

of the third and fourth levels would not comply with international law. On the contrary, if this term is interpreted more broadly – thus admitting that human control is 'meaningful' when it is carried out by a human individual, regardless of its location –, the *shore-based operator*[82] in charge of a remotely controlled ship may be still considered as the shipmaster in charge of navigation. In light of this, the use of MASS of the third level would comply with the law of the sea, while, however, the use of fully-autonomous MASS would not fulfil this legal requirement.

From yet another angle, finally, it is not clear whether the work of code-programming the decision-making algorithms in charge of the MASS could be seen as an exercise of (meaningful?) human control over a ship; if one adheres to this interpretation, even fully autonomous navigation would be under the command of a human operator, i.e. the code-programmer of artificial intelligence systems. In other words, should this person be considered the master of the ship from an international legal perspective, the principle of MHC would be respected even in the case of MASS of the fourth level.

In the last few years, several scholars have already paid attention to the evolution of the role of the master in autonomous navigation. Albeit not reading this issue as an 'overture to MHC at sea', the majority of them are of the view that the legal concept of 'shipmaster' may be dynamically interpreted in the sense to comprehend even new forms of maritime human control, such as the activities carried out by the shore-based operator.[83] In a nutshell, the absence of a human individual controlling the ship *on board* would not be particularly critical: accordingly, the use of remotely-controlled MASS (third level) would comply with international law. On the other side, instead, the adoption of this position would necessarily bring to the conclusion that fully autonomous MASS would be illicit because of the absence of any human in charge of navigation, not even from shore.

What is more, some authors have gone so far as to envisage that, even in the case of fully autonomous navigation, instead, the code programmer of the

82 For a legal analysis concerning this new maritime figure, see Luca Ancis, 'Navi pilotate da remoto e profili di sicurezza della navigazione nel trasporto di passeggeri' (2019) 32(2) Diritto dei Trasporti 437; Umberto La Torre, 'Navi senza equipaggio e *Shore Control Operator*' (2019) 2(2) Diritto dei Trasporti 497.

83 Gabriele Asta, 'Navi-drone e obbligo di internazionale di prestare soccorso in mare' (2021) 1 Rivista del Diritto della Navigazione 243; Baughen (n 59); Natalie Klein, 'Maritime Autonomous Vehicles within International Law Framework to Enhance Maritime Security' (2019) 95 International Law Studies 244, 265; Paul Pritchett, 'Ghost ships: Why the law should embrace unmanned vessel technology' (2016) 40 Tulane Maritime Law Journal 197, 209; Comité Maritime International, 'CMI International Working Group Position Paper on Unmanned Ships and the International Regulatory Framework' (Position Paper, 2018) <https://comitemaritime.org/wp-content/uploads/2018/05/CMI-Position-Paper-on-Unmanned-Ships.pdf> accessed 30 May 2024, 1. On the opposite advice, see Schelin (n 73) 276; Van Hooydonk (n 10) 410.

decision-making algorithms should be legitimately considered the shipmaster in charge of the ship.[84] The eventual acceptance of this highly permissive theory would completely weaken the principle of MHC of its normative relevance; if the mere fact that a human has programmed the AI system will be sufficient to satisfy the MHC requirement, the existence (or not) of individuals in the decision-making loop would be substantially irrelevant.

At the state of the art, it is practically impossible (and maybe even useless) to understand which of these interpretations should be preferred. This is because, in the contextual lack of States' practice on this debate, there is no forecast on whether and how international legal subjects will start behaving in this regard. The contemporary age is marked by a process of *technological transition*; while new challenges are clearly visible, there is still no evidence about how States will intend to address them.

That being said, however, it must be added that the IMO is already working on a process of revision of its treaties in order to overcome some regulatory issues posed by autonomous navigation.[85] In this regard, many international rules dealing with the figure of the shipmaster should be considered.[86] Although this work of revision is not precisely aimed at defining the meaningfulness of human control over the activity of navigation, it is possible that some important novelties will come from the conclusion of this preliminary work. Very recently, the IMO Maritime Safety Committee has published the first draft the non-mandatory 'MASS Code'. [87] This document ask States to ensure the necessary presence of a human individual in charge of MASS navigation. Even considering fully autonomous ships, the MASS Code affirms that: 'the ship-owner must identify *the person responsible for managing the fully autonomous ship*, who performs all the functions and duties assigned to the ship's master by applicable international instruments and the regulations of the flag State of the autonomous ship'. [88] Where this non-binding document receives consideration from States, the

84 This solution has been hypothetically advanced by Coito (n 51) 270.

85 As already noted, the IMO has already concluded the first regulatory scoping exercises on MASS (MSC.1/Circ.1638, 'Outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships' (MASS), 3 June 2021; LEG.1/Circ.11, 'Outcome of the Regulatory Scoping Exercise and Gap Analysis of Conventions Emanating from the Legal Committee with respect to Maritime Autonomous Surface Ships (MASS)', 15 December 2021). Next steps will be expected in the next future.

86 MSC.1/Circ.1638, 9: "[…] some common potential gaps and/or themes were regarded as high-priority issues that cut across several IMO instruments and might require a policy decision before addressing individual instruments. Among those are, for instance: .1 meaning of the terms *master*, *crew* or responsible person; .2 remote control station/centre; and .3 *remote operator designated as seafarer*" (emphasis added).

87 MSC 107/5, Development of a Goal-Based Instrument for Maritime Autonomous Surface Ships (MASS), 27 February 2023.

88 ibid, 5 (emphasis added).

thesis that a human operator shall exist (even from a remote location) might find more justification.

To date, since none of the prospected solutions are somehow endorsed by any State acts or declarations, the process of interpretation of MHC at sea is just a speculative operation. In stark contrast with the debate on the legitimacy of AWS – where many different State positions may be already considered[89] – the topic here analysed is still surrounded by a cryptic silence. Within this scenario, all that remains to do is to look forward to the subsequent agreements and practice of States in applying these international provisions with regard to autonomous navigation.[90] At the state of the art, therefore, the issue of when human control may be considered 'meaningful' at sea is an entirely open question.

6. Conclusive remarks

The way how humans interact with the phenomenological world is the focal point around which international law is built. Even though States are the primary legal subjects of the international legal system, in the final instance, international law speaks to individuals and governs their actions.[91] In a nutshell, international rules are an expression of the normative power regulating human behavior at a supranational level. Once acknowledged this, it follows that, every time technological progress innovates the 'way of doing things',[92] international law is subject to change. For this very reason, the technologies of digitalisation and autonomous control are bringing unexplored legal challenges.

The rise of MASS in the shipping field is a tremendous innovation. This technology revolutionizes the ergonomics of maritime human activities, undermining the common-sense perception of 'navigation'. Intuitively, this technical advancement puts to the test the capacity of the existing norms on navigation to properly regulate the use of innovative means of maritime transport. Within this evolving scenario, the present research has limitedly focused on the unexplored topic of the potential illegitimacy of autonomous ships for the simple fact of being independent of (meaningful) human control.

89 See s 2 of this paper.

90 This author avails of the hermeneutical criterion as codified in art 31(3) (a) and (b) of the VLCT, pursuant to which the process of treaty interpretation takes into account 'any subsequent agreement between the parties regarding the interpretation of the treaty or the application of its provisions', and 'any subsequent practice in the application of the treaty which establishes the agreement of the parties regarding its interpretation'.

91 Dionisio Anzilotti, *Il diritto internazionale nei giudizi interni* (Zanichelli 1905) 52. More recently, this approach to the study of international law has been proposed by Antonio Cançado Trinidade, *International Law for Human Kind. Towards a New Jus Gentium* (Martinus Nijhoff Publishers 2020).

92 See n 51.

To date, one may wonder whether the above analysis is a useful exercise. As noted in the previous pages, indeed, the chosen topic is an entirely 'uncontaminated field': as far as this author knows, no State or International organization has already tackled it. This fact in itself precludes the possibility to reach positive solutions to the proposed legal questions. Unlike the field of humanitarian law,[93] in fact, there still is no evidence of the progressive development of any new rule in the law of the sea about MHC. Furthermore, even if the binding nature of this requirement may be presumably reached through the evolutionary interpretation of the rules on shipmaster's duties (section 4), also this line of argument does not provide a useful indication about its normative content, thus leaving this field open to any possible scenario (section 5).

In synthesis, the above conducted analysis has led to more questions rather than answers. Their relevance, however, should not be underestimated.

First of all, the (hoped) prosecution in the study of MHC at sea looks particularly promising to generally increase *State attention on autonomous ships and their international legal implications*. When dealing with the 'twin' debate on AWS, it was noted that the indefinite nature of MHC is somehow encouraging States to join this discussion without excessive fears:[94] for the same reason, it should not be excluded that a similar result may occur even in this respect. Moreover, if one looks at the historical evolution of the law of the sea in the last decades, this would not be the first time that States started facing new themes when particularly attracted by a 'vague but inspiring' principle. As a clear example of this, it is well known that the final process of negotiation of the UNCLOS[95] was strongly influenced by the indefinite and (at the time) futuristic concept of the *common heritage of humankind*.[96] From this perspective, therefore, even 'just

93 As it has been noted in s 2, this thesis is progressively gaining some consideration in scholarship. In particular, see n 20.

94 See n 35.

95 UNCLOS (n 42). To date, 168 States are parties to the present treaty.

96 As known, the first step of the third and definitive process of negotiation on the Convention on the Law of the Sea (UNCLOS III) started with the renowned speech of the Maltese Ambassador Arvid Pardo, during the United Nations General Assembly, Twenty-second session, 1 November 1967. This principle is now codified in art 136 of UNCLOS. For an in-depth study on the principle of the common heritage of humankind, among many others, see María Fernanda Millicay, 'The Common Heritage of Mankind: 21st Century Challenges of a Revolutionary Concept' in Lilian del Castillo (ed), *Law of the Sea, From Grotius to the International Tribunal for the Law of the Sea* (Brill 2015), 272; Rudiger Wolfrum, 'Common Heritage of Mankind' (2009) Max Planck Encyclopedia of International Law; Markus Schmidt, *Common Heritage or Common Burden? The United States Position on the Development of a Regime for Deep Seabed Mining in the Law of the Sea Convention* (OUP 1989). Albeit this author is conscious that the official terminology provided by UNCLOS uses the word 'mankind', a more recent approach prefers to use the gender-balanced expression 'humankind'. For a detailed analysis about gender implications in the regime of the law of the sea, see Irini Papanicolopulu (ed), *Gender and the Law of the Sea* (Springer 2019).

speculative' reflections about the principle of MHC at sea may potentially contribute to increasing the attention of the international community regarding the phenomenon of autonomous navigation.

Above and beyond this reflection, a final consideration seems to be inspired by what discovered in the course of this work. If until today the concept of MHC has been limitedly observed concerning AWS, this research has suggested the possibility to broaden the scope of this study beyond the regime of international humanitarian law. As noted in the previous pages, indeed, even the law of the sea appears to be challenged by the rise of digital technologies. What is more, these could not be the unique two fields of law in which the concept of MHC acquires a certain relevance in the contemporary age: since digital technologies are contributing to redefining the ergonomics of almost every human activity, every international legal regime may be potentially challenged by the progressive development of this principle. For this reason, it looks particularly interesting to start conceiving the debate on MHC not just as a niche topic of humanitarian law (or of the law of the sea), but as a new issue regarding the international legal system as a whole.

In a nutshell, if it is true that international law, like any other set of rules, is necessarily founded on the 'the way of doing things', the rise of a new paradigm of human behaviour, such as the use of automation, introduces new and *general* questions of international law, which as such deserves to be addressed.