SALVAGE AND AUTONOMOUS MARITIME NAVIGATION

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SUMMARY: 1. The concept of «autonomous transport» in the international regulatory framework – 2. The definition of MASS - 3. The degrees of autonomy of a MASS for the MSC – 4. The level of control definition developed by the European Defence Agency Safety and Regulations for European Crewless Maritime Systems (SARUMS) group/1 – 5. The draft of MASS code – 6. The integration of MASS under the Salvage Convention – 7. Specific issues that arise from the application of the Salvage Convention to the MASS – 8. The Salvage reward of a MASS operation – 9. The role of the master of a MASS in the Salvage Convention – 10. The authority to conclude contracts for salvage operations – 11. Service rendered notwithstanding the prohibition of the master – 12. The role of the Remote Operation Centre (ROC) – 13. The role of the remote operator in the salvage operation – 14. The duty to Assist Persons in Distress at Sea in a salvage operation with MASS – 15. The Legal sources of the obligation to provide assistance – 16. Jurisdiction

1. – On a global level, there is a growing awareness that technological progress will bring great opportunities to the shipping industry for simplifying processes and generating greater automation, as well as is clear that "new, emerging and advancing technologies will foster a more digitalized, interconnected and efficient industry closely integrated with the global supply chain" [1]. The principal international organizations have embarked on a process of analysis of the phenomenon and of introduction of specific regulations for autonomous transport, which, according to the European Parliament "covers all forms of remotely piloted, automated, connected and autonomous ways of road, rail, waterborne and air transport" [2].

There is a growing commitment to balancing the benefits derived from

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[1] See in this regard the IMO Assembly Resolution A.1173(33), adopted on 6 December 2023 (Agenda item 8), *Strategic Plan for the Organization for the Six-Year Period 2024 to 2029*, 11 December 2023, p. 6.

[2] European Parliament resolution of 16 February 2017 with recommendations to the Commission on *Civil Law Rules on Robotics* (2015/2103(INL)).

new technologies with maritime safety and security concerns, including cybersecurity, with costs and the impact on work and with the environmental sustainability concern.

As far as this examination is concerned, we can also add that the ultimate goal of autonomous ships will be the total replacement of seafarers with onboard software that allows a lower number of accidents caused by human error, especially in hostile environments where assistance is required for men, things and vessels in the water environment [3].

In this regard, already in June 2017, the Maritime Safety Committee noted that the maritime sector was witnessing an increased deployment of Maritime Autonomous Surface Ships (MASS) to deliver safe, cost-effective and high- quality results. But there was still a lack of clarity on the correct application to them of existing IMO instruments.

To this end, MSC 98 included in its 2018-2019 biennial agenda an output on Regulatory scoping exercise (RSE) for the use of MASS, and at MSC 99 (May 2018), and the Committee started to develop a framework for the RSE and defined the aim, the objective, the preliminary definition of MASS and degrees of autonomy, the list of mandatory instruments to be considered, including mandatory and non-mandatory conventions, codes, guidelines, recommendations, etc.

MSC 100 (December 2018) approved the framework for the RSE, which contained definitions, a methodology consisting of a two-step approach and a plan of work and procedures (MSC100/20/Add.1, annex 2), while MSC 103 (May 2021) finalized the RSE and approved the outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ship.

On 2 May 2023 the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session issued a report focused on the role and the responsibilities of the master of a MASS. Finally, the MSC, at its 107th session, established the Correspondence Group on Development of a goal-based instrument for Maritime Autonomous Surface

[3] See on this topic M. Suri, *Maritime Autonomous Surface Ships (MASS) and the Salvage Convention*, NUS Centre for Maritime Law Working Paper 22/05 NUS Law Working Paper No 2022/016, 2022, p.2. For the Author "However, there will inevitably be occasions where MASS will still require external help, which brings to the fore the issue of maritime salvage, as well as the applicability of the International Convention on Salvage 1989 (the Salvage Convention) to salvage operations involving MASS".

Ships (MASS) (the Group), under the coordination of the Marshall Islands. Taking into account the comments and decisions made at MSC 107, the Group continued the development of the non- mandatory goal-based MASS instrument (MASS Code).

2. – As mentioned above, the Maritime Safety Committee, at its 103rd session (5 to 14 May 2021), approved the Outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS) [4], acronym constantly used as a technical term to indicate the categories of remotely operated ships or fully autonomous ships [5]. In this regard, For the purpose of the RSE, "MASS" is defined as a ship which, to a varying degree, can operate independent of human interaction.

Another definition is the one related to the generic category of the Unmanned Maritime Systems (UMS), which includes all systems, associated components and subsystems needed to operate these systems and covers a full UMS system with control system, vehicle, logistics and interacting personnel.

As highlighted by EDA, UMS may in principle contain any surface vehicle, underwater vehicle, amphibious vehicle or combinations of these or hybrid in combination with UAV or other [6]. The UMS can then be distinguished according to the way of control, size, endurance, application and degree of autonomous functionality, further divided into Unmanned Surface

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

[5] The IMO LEG.1/Circ.11 15 December 2021 presented an *Outcome of the Regulatory Scoping Exercise and Gap Analysis of Conventions emanating from the Legal Committee with respect to Maritime Autonomous Surface Ships (*MASS). The aim of the LEG RSE was to determine how safe, secure and environmentally sound MASS operations and the related legal matters might be addressed in IMO instruments. IMO found that MASS is an acronym that includes ships with different levels of automation, from partially automated systems, which assisted the human crew, to fully autonomous systems, which are able to undertake all aspects of a ship's operation without the need for human intervention. According to the more recent MSC 108/4, 13 February 2024, *Development of a goal-based instrument for Maritime Autonomous Surface Ships* (MASS), providing a report of the Correspondence Group on Development of a goal-based instrument for MASS, "The term 'MASS' is used extensively when referring to a ship with remotely operated or autonomous functions. If the term is to be used in this way, it was felt that it should be understood that a 'MASS', in this case, is a ship to which the MASS Code is applied in part or in whole".

[6] European Defence Agency (EDA), *Best Practice Guide for Unmanned Maritime Systems Operations, Design and Regulations*, 2022, p. 16.

Vehicles (USV) and Unmanned Underwater Vehicles (UUV) [7].

According to this classification, Unmanned Maritime Vehicles (UMV) are defined as remotely controlled or autonomous craft, vessel or ship with the ability to function without a bridge crew on board. It can be designed to operate on the surface, semi-submerged and/or underwater; an Unmanned Surface Vehicle (USV) is a vehicle which operates autonomously or is controlled and commanded remotely. It operates with continuous or near continuous contact with the water surface and, when at rest, displaces water and is buoyant; an Unmanned Underwater Vehicle (UUV) is a submersible unmanned maritime vehicle which is operating autonomously or being controlled and commanded remotely. It is able to move with both horizontal and vertical components relative to the surrounding water mass.

MASS is controlled by a "Remote Operations Centre" (ROC), intended as a location remote from the MASS that can operate some or all aspects of the functions of the MASS [8].

Other sources refer to the concept of "Remote Control Centre" (RCC), which identifies the same concept of a site off the ship from which control of an autonomous ship can be executed. It may be located either ashore or afloat and may exercise varying degrees of control; and they also add reference to remote control, understood as operational control of some or all ship operations or functions, at a point remote from the ship, and to the Remote Monitoring, i.e. the monitoring of some or all ship operations or functions at a point remote from the ship [9].

In the draft of a MASS Code [10], the Maritime Safety Committee talks about Remote Control, "when the ship, or functions within the ship, are operated

[7] European Defence Agency (EDA), *Best Practice Guide for Unmanned Maritime Systems Operations, Design and Regulations,* 2022, p. 15. In addition, NATO defines Maritime Unmanned Systems (MUS) as "systems operating in the maritime environment (subsurface, surface, air), whose primary component is at least one unmanned vehicle. An unmanned vehicle is defined as a powered vehicle that does not carry a human operator and can: a) be operated autonomously or remotely, b) be expendable or recoverable, c) carry lethal or non-lethal payloads" (p. 15).

[8] IMO Maritime Safety Committee, 108th session, Agenda item 4, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the Correspondence Group Submitted by Marshall Islands, MSC 108/4 13 February 2024.

[9] Maritime UK, Maritime Autonomous Ship Systems (MASS) *UK Industry Conduct Principles and Code of Practice, A Voluntary Code*, Version 6 November 2022, p. 22.

[10] The MASS Code Draft will be discussed in the following paragraphs.

from outside the [controller area network of the] ship without interference from anyone on board the ship. Remote control may have direct control of actuators on board, or may just give functional commands to an autonomous function (system). Remote control may have varied complexity, from simple communication of setpoints to full real time control including full virtual feedback from the ship/function. (Denmark suggestion from 1.2 (application))".

MSC also identifies further definitions for the Remote Control Station, which means a system connected to MASS for its remote control; for the Control stations, which are spaces in which the ship's radio or main navigating equipment or the emergency source of power is located or where the fire recording or fire control equipment is centralized (SOLAS Chapter II – 18). Further definitions identified are those of the Control and monitoring equipment, i.e. the equipment installed for the effective operation and control of the BWMS and the assessment of its effective operation (Ballast Water Management System (BWMS) Code, and of Control Station, i.e. the space in which the craft's radio or navigating equipment (main displays and controls for equipment specified in 13.2 to 13.7) or the emergency source of power and emergency switchboard is located, or where the fire recording or fire control equipment is centralized, or where other functions essential to the safe operation of the MASS craft such as propulsion control, public address, stabilization systems, etc., are located (High Speed Craft Code).

Moreover, Operating station means a confined area of the operating compartment equipped with necessary means for navigation, maneuvering and communication, and from where the functions of navigating, maneuvering, communication, commanding, conning and lookout are carried out.' (High Speed Craft Code); Control station means a single or multiple position including all equipment such as computers and communication terminals and furniture at which control, and monitoring functions are conducted. (ISO 11064-3); Remote Control Station means a place from which MASS, or functions of a MASS can be operated. A ROC may have multiple control stations within its facilities.' (MASS Code Remote Operation Section 3.2).

Finally, the draft MASS code identifies the Remote Operator as a qualified person who is employed or engaged to operate some or all aspects of the functions of a MASS from a Remote Operations Centre.

3. – As mentioned in the previous paragraphs, MSC 98 included in its 2018-2019 biennial agenda an output on "Regulatory scoping exercise for the use of Maritime Autonomous Surface Ships (MASS)" and MSC 103 (May 2021) approved the Outcome of the Regulatory Scoping Exercise for the use of Maritime Autonomous Surface Ships (MASS). In the above-mentioned context, the aim of the regulatory scoping exercise was to determine how safe, secure and environmentally sound MASS operations might be addressed in IMO instruments, while the objective of the RSE on MASS conducted by MSC was to assess the degree to which the existing regulatory framework under its purview might be affected in order to address MASS operations [11].

For the purpose of RSE, "MASS" is intended as a ship which, to a varying degree, can operate independent of human interaction, and the different degrees of autonomy are so identified: degree one, relating to a 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, related to Remotely controlled ship with seafarers on board: The ship is controlled and operated from another location, but Seafarers are available on board to take control and to operate the shipboard systems and functions; degree three, encompassing the Remotely controlled ship without seafarers on board: in this case the ship is controlled and operated from another location. And there are no seafarers on board; degree four, related to Fully autonomous ship: in this case the operating system of the ship is able to make decisions and determine actions by itself. The list is not in a hierarchical order, since MASS could be operating at one or more degrees of autonomy for the duration of a single voyage. Based on this distinction, Member States conducted, on a voluntary basis, a review of international conventions and juridical instruments in two steps, the first of which is an initial review of each article or sub-paragraph of each instrument and, for each degree of autonomy, one of the following answers was allocated to each provision: A: apply to MASS and prevent MASS operations; B: apply to MASS and do not prevent MASS operations and require no actions; C: apply to MASS and do not prevent MASS operations, but may need to be amended or clarified, and/or may

[11] Maritime Safety Committee (MSC), 100th session, 3–7 December 2018.

contain gaps; D: have no application to MASS operations [12]. As a second step, an analysis was conducted to determine the most appropriate way of addressing MASS operations, taking into account the human element, by: (I) developing interpretations; and/or (II) amending existing instruments; and/or (III) developing new instruments; or (IV) none of the above as a result of the analysis [13].

In the case of the International Salvage Convention 1989 (Salvage 1989) it was considered that no modification or interpretation is necessary for degrees one and two, while for degrees three and four of autonomy it is necessary to develop an interpretation of the Convention under analysis [14].

4. – A further classification of the different degrees of autonomy of a MASS has recently been proposed by the European Defence Agency Safety and Regulations for European Crewless Maritime Systems (SARUMS) group, which has adopted a MASS categorising System based on level of control of the means of transport [15].

The level of control definition has five different degrees: the 0 crewed

[12] IMO LEG.1/Circ.11 15 December 2021, p. 4.

[13] IMO LEG.1/Circ.11 15 December 2021, p. 5.

[14] IMO LEG.1/Circ.11 15 December 2021, p. 38. Some Authors, such as M. Suri, *Maritime Autonomous Surface Ships (MASS) and the Salvage Convention*, NUS Centre for Maritime Law Working Paper 22/05 NUS Law Working Paper No 2022/016, 2022, p.4, take an orientation contrary to that advocated by IMO: "This approach, which focuses on merely plugging existing gaps, rather than developing the existing Salvage Convention framework to accommodate future developments in MASS, seems not to have been informed by a firm understanding of MASS operations.12 Additionally, the Scoping Exercise seems to have ignored the significant proviso in the Finland document: 'if the issue of a master is dealt with in a separate instrument'. The Scoping Exercise should arguably at least have assessed the issue of a separate MASS instrument by giving an opinion on this issue. The replacement of the words 'separate instrument' in the Finland document with 'all instruments in coordination with all responsible committees' in the final Scoping Exercise report further fudges the issue".

[15] European Defence Agency, Best Practice Guide for Unmanned Maritime Systems Operations, Design and Regulations, 2022. In that regard, it should be added that SARUMS BPG is the outcome of the European Defence Agency (EDA) Research Technical Proposal (RTP) "Safety and Regulations for European Unmanned Maritime Systems" of 18 March 2011, with the following establishing Member States: Belgium, Germany, Finland, France, Italy the Netherlands and Sweden, in close coordination with DCNS (FR) and SAAB (SE). The 2022 edition was established under the framework of the EDA ad-hoc working group "Safety and Regulations for Unmanned Maritime Systems" (AHWG SARUMS) with the support of the following additional participants: Poland and Portugal.

MASS, controlled by operators aboard; the Operated control, where all cognitive functionality is within the human operator. The operator has direct contact with the MASS over e.g., continuous radio (R/C) and/or cable (e.g., tethered UUVs and ROVs). The operator makes all decisions, directs and controls all vehicle and mission functions; the Directed control, where some degree of reasoning and ability to respond is implemented into the MASS. It may sense the environment, report its state and suggest one or several actions. It may also suggest possible actions to the operator, such as e.g. prompting the operator for information or decisions. However, the authority to make decisions is with the operator. In this case, the MASS will act only if commanded and/or permitted; the Delegated control, under which the MASS is authorised to execute some functions. It may sense environment, report its state and define actions and report its intention. The operator has the option to object to (veto) intentions declared by the MASS during a certain time, after which the MASS will act. In this hypothesis the initiative emanates from the MASS and decision-making is shared between the operator and the MASS; the Monitored control, where the MASS will sense environment and report its state. The MASS defines actions, decides, acts and reports its action. The operator may monitor the events; the Autonomous level, for MASS that senses environment, defines possible actions, decides and acts. In this last stage the Crewless Vessel is afforded a maximum degree of independence and self-determination within the context of the system capabilities and limitations. Autonomous functions are invoked by the on-board systems at occasions decided by the same, without notifying any external units or operators.

The levels of control indicated here should be considered alongside the degrees of autonomy mentioned above.

The document considers that the levels of control may be different for different functions aboard the same MASS, and they may change during a voyage. Take, for example, a cargo ship voyage, which might comprise loading, departure, voyage, arrival and unloading. These phases might each be subject to different levels of control (LoC), of speed or maneuvering.

5. – The Maritime Safety Committee Correspondence Group on Development of a goal-based instrument for Maritime Autonomous Surface Ships

(MASS), in 108th session, developed [16] a draft of a non-mandatory goal-based MASS Code, which should be non-mandatory but developed such as to facilitate its eventual transfer to a mandatory code; be supplementary to existing instruments (not "standalone") and only address matters that are either not addressed in existing instruments or that require alternative approaches due to the nature of the MASS mode of operation; be goal-based and take account of the Generic guidelines for developing IMO Goal-based Standards (MSC.1/Circ.1394/Rev.2) and the Principles to be considered when drafting IMO instruments (resolution A.1103(29)); and address the impact of autonomy on critical "functions" rather than attempting to address the ship as a whole.

The purpose of this Code is to provide an international regulatory framework for the remote control and autonomous operation of key functions and ensure safe, secure, and environmentally sound MASS operations. It further aims to support the safe adoption and integration of new technology for ship operations and provide for consistency of approach to the design, build and operation of MASS.

MASS Code is developed for cargo ships: nevertheless, the Committee is called upon to consider extending the application of the MASS Code to passenger ships immediately after the non-mandatory MASS Code is approved and, using the regulation developed for cargo ships, regulating autonomous passenger ships in terms of the same functions.

With reference to the functions of Search and Rescue, of interest to this survey, the draft of the MASS Code clarifies that "Every MASS should be able to provide assistance to persons in distress at sea as far as such action may reasonably be expected of it [17]". To achieve this, "the ship should be able to receive distress information from any source, included search and rescue service information and means should be provided to correlate the MASS own status and any given distress signal, and its ability to render assistance. MASS should be able to coordinate with coastal State SAR service if its cooperation is required or participation is necessary". Particular attention is paid to the ability

[16] See the IMO Maritime Safety Committee, Development of a goal-based instrument for maritime autonomous surface ships (MASS), Report of the Correspondence Group Submitted by Marshall Islands, 108th session, Agenda item 4, MSC 108/4 13 February 2024.

[17] IMO Maritime Safety Committee, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the Correspondence Group Submitted by Marshall Islands, 108th session, Agenda item 4, MSC 108/4 13 February 2024, p. 50.

of the MASS to recognize signals and objects at sea and to communicate their presence and any risk inherent to the ROC. To this end, "every MASS should be able to detect distress signals, MASS sensors should be able to collect environmental data and share them with the Remote Operations Centre (ROC), MASS should be able to detect, recognize, and identify objects and lights, MASS should be able to identify distress signals of COLREGs Annex IV. If within its operational envelope, MASS should be able to establish relative bearing and distance to detected objects. MASS should be able to locate distress signals. MASS should be able to locate distress signals with bearing and distance or with latitude and longitude, according to the detection system. If within its operational envelope, MASS should be able to trace a course to the point where distress signal is located" [18].

The part of the draft relating to the rescue of people in danger is also important: for the draft, indeed, "Every MASS should proceed with all possible speed to the rescue of persons in distress", and, in this perspective, it should be able to identify the possible speed to go to the area where persons in distress. To this end, MASS, with or without crew on board, should have means to recover persons in distress, and it should have, included in the emergency management system, specific plans, procedures and training and drills for the rescue of persons in distress, as well as manuals available to the master and officers in charge of the MASS.

In the event of a collision with other ship, MASS is required to render assistance and provide information, and means to address the capability of ship to render assistance to the other ship, its crew and its passengers after a collision should be provided, included damage sustained and environmental factors. MASS should have a sheltered space on board from harsh meteorological conditions to accommodate retrieved persons in distress until is able to deliver them to a place of safety.

The contribution that the remote master can provide is also important: in fact, he is required to lead on-scene SAR activities, and in order to conduct SAR activities means to ensure that master is able to lead SAR activities, including communication and coordination of surface search, should be

[18] IMO Maritime Safety Committee, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the Correspondence Group Submitted by Marshall Islands, 108th session, Agenda item 4, MSC 108/4 13 February 2024, p. 51.

provided, as well as master's authority and responsibility to make decisions on SAR operations, should be assured.

In any case, MASS, with or without crew on board, should be able to maintain distress communications (directly and through ROC), and it should be able to emit and to receive distress communications, including ship to shore distress alerts.

Finally, the draft of MASS Code provides that every MASS vessel with persons on board should have a responsible master on board for leading activities on board MASS during distress situations. Master of the vessel shall also facilitate safe access and guidance of external rescue staff on board [19].

6. – It is generally considered that soon the presence of MASSs in the seas will increase, and that the transport of goods, and afterwards of people, could be entrusted to totally autonomous ships and led by an artificial intelligence [20]. The benefit in terms of environmental protection is clear: an unmanned ship can use alternative sources of energy supply to power itself and, in any case, it produces a lower fuel consumption. The use of MASS can also reduce the risk of human error that can be identified in many maritime accidents [21].

It is believed that Maritime Salvage law generally applies to MASS [22],

[19] IMO Maritime Safety Committee, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the Correspondence Group Submitted by Marshall Islands, 108th session, Agenda item 4, MSC 108/4 13 February 2024, p. 58.

[20] As highlighted by A. Weiger and S. Pribyl, *The future is now: unmanned and autonomous surface vessels and their impact on the maritime industry*. Blank Maritime Bulletin, 2017.

[21] See the report of Allianz (2019) *Shipping safety - Human error comes in many forms*. Agcs.allianz.com. On the human error in the road traffic incidents, see also the Report of the eSafety Working Group (2002), reported by the Commission to the European Parliament and the Council (2016) *Saving Lives: Boosting Car Safety in the EU - Reporting on the monitoring and assessment of advanced vehicle safety features, their cost effectiveness and feasibility for the review of the regulations on general vehicle safety and on the protection of pedestrians and other vulnerable road users* {SWD(2016) 431 final}: 4.

[22] On this subject, allow us to refer to C. Severoni, *Salvage and Autonomous Maritime Navigation, The Regulation of Automated and Autonomous Transport*, Springer, 2022, 167 ss. Other scholars (B. Soyer, A. Tettenborn, G. Leloudas, *Remote controlled and Autonomous Shipping: UK based case study*, 2022, p. 16) argue that "In fact a good deal of it carries across quite neatly to autonomous (…). For example, this is certainly true as regards subject-matter. Under the 1989 Convention salvage applies to any "vessel" or "property", a "vessel" being defined as "any ship or craft, or any structure capable of navigation". There can be no serious doubt that this includes a MASS. Again,

without any modification or interpretation for the MASS presenting degrees one and two of autonomy, while for degrees three and four of autonomy it is necessary to develop an interpretation of the Convention under analysis [23].

In that regard, the IMO Legal Committee (LEG - 108th session (26 to 30 July 2021) approved the above-mentioned *Outcome of the Regulatory Scoping Exercise and Gap Analysis* of *Conventions emanating from the Legal Committee with respect to Maritime Autonomous Surface Ships* (MASS), clarifying that the most appropriate way to apply the Salvage Convention to

if an abandoned vessel is found and brought safely to port, it fairly clearly makes no difference to the nature of the services, or the remedy available to the person providing them, whether was originally crewed or uncrewed".

[23] IMO LEG.1/Circ.11 15 December 2021, p. 4. On this topic in general, see L. Ancis (2019) *Navi pilotate da remoto e profili di sicurezza della navigazione nel trasporto di passeggeri*. *Dir. trasp*.: 460; S. Ardito, D. Lazarevs, B. Vasiliniuc, ZK. Vukic, ZK. Masabayashi, M. Caccia, *Cooperative Autonomous Robotic Towing system: definition of requirements and operating scenarios*, 2013 https://doi.org/10.3182/20120919-3-IT-2046.00045; FG. Attard, RL. Kilpatrick, *Reflections on the Maersk Etienne Standoff and its Ramifications for the Duty to Render Assistance at Sea*, 2020; R.A. Barnes, *Article 18 United Nations Convention on the Law of the Sea. A Commentary*, edited by A. Proelß, 2017, 185; H.C. Burmeister, WCØ Bruhn, J. Rodseth, T. Porathe, *Can unmanned ships improve navigational safety*?. Transport Research Arena, 2014; A. Calantropio, *The Use of UAVs for Performing Safety-Related Tasks at Post-Disaster and Non-Critical Construction Sites*, 2019. MDPI 5, 64; doi:10.3390/safety5040064; J.P. Craven, *Technology and the law of the sea: the effect of prediction and misprediction,* Louisiana Law Rev., 1985, 1143–1159; S. Crisafulli Buscemi, *Alcune considerazioni sulla situazione giuridica della nave manovrabile da lontano.* Studi in onore di Francesco Berlingieri, 1933, 191–204; M. Davies, *Obligations and implications for ships encountering persons in need of assistance at sea.* Pac Rim Law Policy J 2003, 109; H. Ghaderi, *Autonomous technologies in short sea shipping: trends, feasibility and implications.* Transport Rev 2019, 39:152 ss.; Kas KA, G.K. Johnson, *Using unmanned aerial vehicles and robotics in hazardous locations safely*. Process Saf Progr, 2020, 39: https://doi.org/10.1002/prs.12096; FJ JR Kenney, V. Tasikas, *The Tampa incident: IMO perspectives and responses on the treatment of persons rescued at sea.* Pac Rim Law Policy J, 2003, 12:151; R. L. Kilpatrick, *The "Refugee Clause" for commercial shipping contracts: why allocation of rescue costs is critical during periods of mass migration at sea.* Georgia J Int Comp, 2010; M. Kurowsky, H. Korte, B. P. Lampe, *Search-and-Rescue-Operation with an Autonomously Acting Rescue Boat. Autonomous and intelligent Systems: third international Conference*, in Lecture Notes in Artificial Intelligence, 2012, AIS; S. Lagrone, *Ghost Fleet Ship 'Nomad' Arrives in California After 4,421 Nautical-Mile, '98 Percent' Autonomous Trip*, 2021; D. Mandrioli, *The international duty to assist people in distress at sea in the era of unmanned navigation: no place for people on board*. Revista multidisciplinar humanidades e tecnologia, 2020, 91; N. Nevejans *European Civil Law Rules on Robotics*, 2016; R. O'Rourke, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress*, 2022, available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=; I. Papanicolopulu, *International law and the protection of people at sea,* Oxford, 2018, 187; H.

MASS was to develop interpretations for degrees of autonomy three and four, while no changes are planned for degrees one and two.

In detail, art. 1(b) of the Salvage Convention refers to vessel, and «Vessel means any ship or craft, or any structure capable of navigation». This definition is considered to include MASS, that is a general term used to refer to systems of a remotely operated, semi- autonomous, or autonomous nature. The rule does not expressly provide for the hypothesis of a remotely operated or autonomous ship, but it is believed that the definition is sufficiently generic to also include the salvage carried out with MASS.

It is also considered that the Salvage Convention covers both the case of a salvage to a MASS, that the salvage rendered with a MASS. In this second case, the lack of crew on board may reduce the risk to life of the crew.

Remotely piloted MASS, capable of bringing assistance at sea, are already on the market. Specific examples are the Autonomous emergency response vessels [24], among which we can mention projects of vessels, whose aim is to replace, also partially, humans' intervention in dangerous or repetitive scenarios, developed by naval architects, as for example an unmanned fire-fight-

Ringbom *Regulating autonomous ships—concepts, challenges and precedents*, Ocean Dev Int Law, 2019, 50(2–3):141–169; R. Saha, *Mapping competence requirements for future shore control center operators*, Maritime Policy Manage, 2021; SI Savitz, P. Blickstein, RW Buryk, P. Button, J. Deluca, J. Dryden, J. Mastbaum, P. Osburg, A. Padilla, CC. Potter, L. Price, SK Thrall, RJ. Woodward, J. Yardley Yuchak U.S. *Navy Employment Options for Unmanned Surface Vehicles* (USVs), Rand – National Defense Research Institute, 2013; C. Severoni, *La remunerazione del soccorso tra interesse pubblico ed interessi privati – Premesse storico-dogmatiche*, 2005 a, vol. I; ID., *La remunerazione del soccorso tra interesse pubblico ed interessi privati – Profili sistematici e lineamenti evolutivi,* 2005b, vol. II; ID., *Soccorso e mezzi di trasporto autonomi.* Dir Trasp. 2018, 31(1), 67–85; B. Soyer, A. Tetenborn, *Artificial intelligence and autonomous shipping: developing the international legal framework,* Bloomsbury Publishing, 2021, 63–89; M. Starita, *Il dovere di soccorso in mare e il diritto di obbedire al diritto (internazionale) del comandante della nave privata*. Diritti um. Dir. Intern., 2019, https://doi.org/10.12829/93310; R. Veal, *Maritime surface ships: autonomy, manning and the IMO,* Lloyd's Ship Trade Law, 2018, 18(5):1–4; R. Veal, M. Tsimplis, A. Serdy, The legal status and operation of unmanned maritime vehicles. Ocean Dev Int Law, 2019, 50, 23–48; AM. Weiger, ST. Pribyl, *The future is now: unmanned and autonomous surface vessels and their impact on the maritime industry*, Blank Maritime Bulletin, 2017; R-J Yan, S. Pang, H-B Sun, YJ. Pang, *Development and missions of unmanned surface vehicles,* J Mar Sci Appl, 2010, 451; J. Yoo, F. Goerlandt, A. Chircop, *Unmanned remotely operated search and rescue ships in the Canadian arctic: exploring the opportunities, risk dimensions and governance implications*, In: Chircop A, Goerlandt F, Aporta C, Pelot R (eds) Governance of arctic shipping. Springer Polar Sciences. Springer, 2020.

[24] Source: rivieramm.com and others.

ing vessel, deployed to be used in case of fire or gaseous conditions, highly dangerous to human.

There are also projects for the use of MASS in the case of oil spill, integrated with technology developed by Sea Machines Robotics and others. Autonomous vessels are also projected for offshore and marine survey by Ocean Infinity and others: these are Shell multi-client seep hunter projects involving unmanned vessels with clean power and intelligent navigation to locate and identify oil and gas seeps in the world's oceans [25]. Another example are the autonomous tugs, whose operation led to the decrease of onboard personnel from 50 to 15 on the 78m vessels, resulting in a notable reduction in associated costs such as flights for crew turnover, hotel loads on the ships and a decrease in fuel consumption [26].

7. – The provision of the use of MASS in a salvage event entails the need to clarify some aspects that emerge from the SALVAGE Convention [27]. In the event of a Salvage operation involving a MASS there are no elements in principle that indicate the absolute incompatibility of the current regulatory system with the presence of it, although in some cases it will be necessary to develop a broad interpretation of the current law to also include MASS.

The concept of salvage operation refers to an activity performed on a ship in distress. However, if, in the assessment of the danger, reference has traditionally been made to the direct eyewitness of the crew, as well as documentary evidence, in the unmanned MASS on board the danger is identified exclusively by cameras and sensors that report to the ROC through a communication system [28].

[25] Source: Oceaninfinity.com.

[26] There are various projects related to autonomous tugboats. See also the study conducted by J. H. Choi, J. Y. Jang, J. Woo, *A Review of Autonomous Tugboat Operations for Efficient and Safe Ship Berthing*, Journal of Marine Science and Engineering, May 2023, 11(6), 1155.

[27] For questions relating to the applicability of the Salvage Convention to assistance operations involving a MASS, please refer to C. Severoni, *Salvage and Autonomous Maritime Navigation,* The Regulation of Automated and Autonomous Transport, Springer, 2022, 167 ss. and other authors referred to here.

[28] Connectivity may be provided by sensors and technology connecting to Global National Satellite Systems. On this topic see S. Krause et al, *Development of an Advanced, Efficient and Green Intermodal System with Autonomous Inland and Short Sea Shipping – AEGIS,* 2022 J. Phys.: Conf. Ser. 2311 012031, p. 12: "Autonomous sailing and vessel operations can be described with several

Regarding the concept of salvage operation, under art. 1 (a) of the Salvage Convention it means «any act or activity undertaken to assist a vessel or any other property in danger in navigable waters or in any other waters whatsoever». There is no specific reference to the human intervention, and it can also cover the hypotheses of a salvage to a MASS in danger in navigable waters or in any other waters, or a salvage operation undertaken by a remotely controlled/ or autonomous ship. Indeed, it is a broad definition that contains the concept of action by the salvor, whose nature is that of assistance [29].

As the concept of salvage operation includes "any act or activity" there is no express requirement that the assistance rendered be of physical character. Thus, also the electronic restoration of a system from land could be intended as a salvage operation, as long as the vessel is in danger, in navigable waters or in any other waters of navigation. In the same way, an entirely shore-based IT-expert who helps to reestablish communication and command of an unmanned ship could be entitled to a salvage award [30]. Companies such

actions that need to be performed for secure and safe sailing. First steps are condition detection and condition analysis. Further steps are action planning, action execution and action control. After executing these steps, the circle of actions is reapplied. For these actions, appropriate sensors and fast decision algorithms are needed. The more and divers the sensors are installed on the vessel, the better and more secure will be the condition detection and action control. Appropriate sensors are optical sensors, e.g. camera and LIDAR (light imaging, detection and ranging) systems as well as other sensors, e.g. radar, etc. Additionally, sensors and technology for GNSS (global national satellite system) are essential for autonomous sailing".

[29] See also M. Suri, *Maritime Autonomous Surface Ships (MASS) and the Salvage Convention,* NUS Centre for Maritime Law Working Paper 22/05 NUS Law Working Paper No 2022/016, 2022, p. 5, for which "Assistance may be either active or passive, such as 'comfort that its presence provided the passengers and crew',(as in Dorothy J v City of New York 749 F Supp 2d 50 (ED NY 2010), or even merely allowing the use of vessel space (as in Sunglory Maritime Ltd v Phi Inc 212 F Supp 3d 618 (ED La 2016). The proposition that MASS in danger, and unable to extricate themselves from that situation, may require help or aid, is uncontroversial".

[30] CMI IWG submission to the MSC 99th session. See also B. Soyer, A. Tettenborn, G. Leloudas, *Remote controlled and Autonomous Shipping: UK based case study*, p. 17. For the Authors "The 1989 Salvage Convention defines salvage services is "any act or activity undertaken to assist a vessel or any other property in danger in navigable waters or in any other waters whatsoever." With autonomous vessels, the saving of the vessel from danger might well entail entirely land-based operations. Examples might include the hiring of IT consultants to sort out an onboard computer failure, or to rescue a vessel under computer control from the clutches of cyber-hackers' intent on taking her over. Such operations deserve to be treated as salvage. We take the view that the Merchant Shipping Act 1995 should be amended to ensure that they are, despite the fact that they may be

as Inmarsat [31] or Spire Global will be able to enter into agreements of various nature with the owners of the MASS to implement connectivity with the ship in distress.

It is also possible to hypothesize a voluntary salvage of a MASS in danger, or with the assistance of a MASS. In this perspective, a borderline case is represented by the hypothesis of a salvage operation spontaneously rendered by a hacker, who blocks the harmful effects of an act of piracy on the MASS management software or its communication system. We should then ask ourselves whether it can be considered a salvage operation according to the Salvage Convention. In this hypothesis, if there is no express and reasonable prohibition of the owner or master of the vessel (art. 19 of London Conv.), we may consider that it is an «act or activity» undertaken to assist a vessel and the salvor will be entitled to a salvage reward if it had a useful result and according to art. 12: «Salvage operations which have had a useful result give right to a reward» (no cure no pay rule).

8. – The rules of the Salvage Convention on salvage reward are also applicable to cases of a salvage operation involving a MASS. However, the absence of crew on board for levels three and four of autonomy poses pressing problems of adaptation of the discipline provided for by the Salvage Convention in cases where a MASS is involved [32].

Under art. 12 "Salvage operations which have had a useful result give right to a reward" (Art. 12), except in the case of a salvage of persons, where "No remuneration is due from persons whose lives are saved" (Art. 16). Nevertheless, "A salvor of human life, who has taken part in the services rendered on the occasion of the accident giving rise to Salvage, is entitled to

entirely land-based".

[31] As highlighted by Inmarsat, The future of Maritime Safety Report 2023, p. 26: "Shipping recognizes the potential of automation and autonomous technologies. Maritime autonomous surface ships (MASS), collision avoidance systems, advanced navigation aids, real- time monitoring of vessel/equipment performance, and others can improve safety and efficiency. Embracing technology, while addressing attendant cyber security risks, is key. If shipping can strike the right balance between human oversight and control on the one hand and machine precision and reliability on the other, it can reap the benefits of enhanced safety management, dynamic risk assessment, and evidence-based decision-making".

[32] On this topic see M. Suri, K. Wróbel, *Identifying factors affecting salvage rewards of crewless vessels — lessons from a case study*, WMU Journal of Maritime Affairs (2022) 21:213–232.

a fair share of the payment awarded to the salvor for salving the vessel or other property or preventing or minimizing damage to the environment" (Art. 16, para. 2).

It is generally recognized that the determination of a salvage reward does not respond to strict rules, but to a principle that can be defined "liberal," i.e., not closely related to the evaluation of the actual costs, nor to a sum that represents the simple consideration (*quantum meruit*) of the salvage services rendered [33], but it is added a component of prize, peculiar element of the salvage reward, which responds to incentive reasons for the assistance rendered.

Even if the aforementioned rules have been foreseen for the hypothesis of a salvage rendered by manned ships, also considering the fact that "the reward shall be fixed with a view to encouraging Salvage operations" (Art. 13), the criteria for determining the remuneration set by Art. 13 should also apply in the case of an autonomous salvage ship, even if these criteria are provided for a traditional salvage operation , such as indicated by the criterion of "the skill and efforts of the salvors in salving the vessel, other property or life" (letter e), or by the reference to the risk of liability or other risks run by salvors (letter g).

There are, however, rules that must be interpreted in order to be applied to salvage operations involving MASS, such as the duty of the salvor to operate with *due diligence* in assisting a ship in danger, even in the specific case of environmental salvage (Art. 8.1 (b) of the Salvage Convention), also seeking assistance and accepting the contribution of other salvors reasonably requested by the shipowner or by the owner of other property at risk (Art. 8.1 (c) and (d)).

Art. 8 of the Salvage Convention provides a detailed list of the main duties of the salvor, which the heading of the article also extends to the ship's master, among which undoubtedly the obligation to operate "with due care" is highlighted: "The salvor shall owe a duty to the owner of the vessel or other property in danger: (a) to carry out the Salvage operations with due

[33] *The Nagasaki Spirit*, Court of appeal, 4, 5, 6 e 21 dec. 1995. In: Lloyd's Law Reports, 1996 (I): 459. For the Court "The need to encourage salvors to undertake unusual risks in the general public interest, combined with recognition of the fact that unsuccessful services or ones where no property was saved resulted in payment of any kind, meant that the rewards for success were generous. The jurisdiction was equitable, and it took account of these factors which were extraneous to the individual case."

care; (b) in performing the duty specified in subparagraph (a), to exercise due care to prevent or minimize damage to the environment; (c) whenever circumstances reasonably require, to seek assistance from other salvors; and (d) to accept the intervention of other salvors when reasonably requested to do so by the owner or master of the vessel or other property in danger; provided however that the amount of his reward shall not be prejudiced should it be found that such a request was unreasonable." In the hypothesis of salvage carried out by a MASS, it is necessary to reformulate these due diligence obligations in view of the fact that the master operates remotely, as well

According to art. 8.2, the master of the vessel, together with the owner of the vessel and the owner of other property in danger, has a duty to the salvor to also co-operate fully with him/her during the course of the salvage operations; in doing so, to exercise due care to prevent or minimize damage to the environment; and when the vessel or other property has been brought to a place of safety, to accept redelivery when reasonably requested by the salvor to do so. In the event that the rescue is carried out to a MASS, it is necessary to identify who is responsible for the duty to cooperate with the salvor during the course of the salvage operations, exercising due care to prevent or minimize damage to the environment. In the assistance to a MASS, it can be assumed that such obligations are attributable to the shore-based master/operator or/and to the shipowner of the ship in danger.

With particular regard to the classification of MASS according to the degree of autonomy, for ships with second degree of autonomy it is still necessary to clarify, according to the Salvage Convention, whether a shore-based operator can be considered as master, or if the role can be attributed to somebody else on board the ship.

For ships with a third-degree autonomy, where there is no crew on board, it should be clarified if the shore-based operator can be considered as master, and in this sense there are important clarifications in the draft of the MASS code that will be dealt with in the following paragraphs, while in totally autonomous ships, with an autonomy of fourth degree, it is necessary to further clarify, in the absence of personnel on board and of a remote control, whether, in the case of a salvage operation with a MASS, the role of salvor can be assumed by other figures such as the programmer of the piloting and management software or the ship or system builder.

As regards the determination of the salvage compensation in the event of a salvage carried by a totally autonomous MASS, we should consider that the skills and efforts are no longer those of the master and crew on board the rescue ship, but hypothetically those of the shore-based operator, of a remote master, or of the shipowner who provides for autonomous management software and adequate equipment on the ship.

If the salvage operation is then carried out by a MASS professionally equipped for the salvage operation, it can increase remuneration under Art. 13 (i) and (j), which sets the salvage compensation on "the availability and use of vessels or other equipment intended for Salvage operations and the state of readiness and efficiency of the salvor's equipment and the value thereof." This item can include the investments and economic efforts made by professional salvors in the purchase of equipment and software of a MASS, which are supposed to reach high costs.

An interpretation of the legal text is also required for the reference to the concept of salvor's negligence or fraud.

In this regard, article 18 of the Salvage Convention states that "a salvor may be deprived of the whole or part of the payment due under this Convention to the extent that Salvage operations have become necessary or more difficult because of fault or neglect on his part or if the salvor has been guilty of fraud or other dishonest conduct."

In a salvage operation carried out by a remotely controlled ship with crew on board, it is necessary to ascertain who can be held responsible for the negligent conduct. But, if the ship is totally autonomous (fourth degree), it could be necessary to examine the negligent conduct of other professional figures, such as the programmers who support the remote operator in the management of the MASS management software, or the shore-based operator.

9. – The IMO has delved into the issues arising from the different functions performed by the ship's master of a MASS, who is still present for levels one and two, while like the rest of the crew, he is no longer on board in levels three and four.

In particular, the Regulatory Scoping Exercise has raised the issue of who can exercise the functions of master if he is no longer present on board, and

also if an owner (or charterer) would have additional duties or liabilities when operating a semi-autonomous or fully autonomous vessel [34]; or if certain responsibilities that would normally belong to the master, would transfer to those actually on board a vessel in cases of semi-autonomous vessels with limited crews, or could be carried out by personnel not on board the MASS [35].

In the draft of a MASS code, the remote master is intended as a master who is in a Remote Operations Centre outside the MASS, and in this perspective the IMO Maritime Safety Committee raised some general issues on the role and responsibilities of the master of a MASS, considering that «there is no need for a new definition for the master of a MASS as MASS are ships and the role of the master is the same as for conventional ships; the functions of the master of a MASS operating MASS require detailed consideration before deciding on his or her roles and responsibilities; consideration of the definition of the master of a MASS would be premature at this stage as it is unclear how fully autonomous ships will be operated and how it will allow for human intervention; the person in charge of MASS operations has to have overall responsibility of a MASS, even for those operating in fully autonomous mode; reference to the terms "command" and "control" when

[34] Some scholars believe that in the case of a remotely controlled MASS the remote operator is the "functional equivalent to the master": N. Klein, *Maritime Autonomous Surface Vehicles within the International Law Framework to Enhance Maritime Security*, 95 Intn'l L. Stud., 244 (2019); while other scholars say that the task of a shore-based vessel controller is not entirely similar to that of a ship's master (E. Van Hooydonk, *The Law of Unmanned Merchant Shipping – an Exploration*, Journal of International Maritime Law, 2014, 403 ss., p. 410.

[35] IMO LEG. 1/Circ. 11, Annex, p. 6. With reference to the Salvage Convention, the IMO considered that for grade three and four MASSs "The issue of the remote operator/master is an overriding issue that needs to be solved taking into account all instruments in coordination with all responsible committees". Other figures arise in the management of a MASS: among these, the figure of the remote operator emerges: "The RSE also showed that it may be necessary to clarify the role and responsibility of the remote operator. In particular, it may be necessary to clarify whether the remote operator might fall within the scope of the terms, including but not limited to, "operator" or "servant or agent", which are used within the liability and compensation regime, in order for the liability, channelling and subrogation provisions in those conventions to clearly accommodate MASS. While the view was expressed that the term "operator" used in the conventions was intended to refer to the commercial operator of a ship, and not a remote operator in the context of MASS, it appears that a clarifying discussion on this issue may be needed. It was noted in document LEG 106/8/4 that the role of the remote operator within the liability regime would have to be considered by the Legal Committee at some stage but was not considered as part of the RSE" (p. 7).

defining the role of the master of a MASS needs to be thoroughly considered; if there is a crew or persons on board, a master should be on board as well, to ensure their safety; and a master of a MASS may not need to be on board, depending on the technology» [36].

Other key principles provided by the draft of the MASS Code the points hereinafter highlighted: there should be a human master responsible for a MASS, regardless of mode of operation; such master may not need to be on board, depending on the technology used on the MASS and human presence on board, if any; and regardless of mode of operation, the master of a MASS should have the means to intervene when necessary. Moreover, several masters may be responsible for a MASS on a single voyage, under certain conditions do be defined, and only one master should be responsible at any given time [37].

The Master appears in some provisions of the Salvage Convention: under art. 6.2: «The master shall have the authority to conclude contracts for salvage operations on behalf of the owner of the vessel. The master or the owner of the vessel shall have the authority to conclude such contracts on behalf of the owner of the property on board the vessel»; under Art.8.2, "The owner and master of the vessel or the owner of other property in danger shall owe a duty to the salvor (a) to co-operate fully with him during the course of the salvage operations; (b) in so doing, to exercise due care to prevent or minimize damage to the environment; and (c) when the vessel or other property has been brought to a place of safety, to accept redelivery when reasonably requested by the salvor to do so". Under Art.10.1, "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". Under Art.15, "The apportionment between the owner, master and other persons in the service of each salving vessel shall be determined by the law of the flag of that vessel". Under Art.19, "Services rendered notwithstanding the express and reasonable prohibition of the owner or master of the

[36] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 4 and 11.

[37] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 9.

vessel or the owner of any other property in danger which is not and has not been on board the vessel shall not give rise to payment under this Convention".

It was anticipated that the MSC-LEG-FAL Joint Working Group agreed on a number of points: "there should be a human master responsible for a MASS, regardless of mode of operation or degree or level of autonomy; such master may not need to be on board, depending on the technology used on the MASS and human presence on board, if any; and regardless of mode of operation or degree or level of autonomy, the master of a MASS should have the means to intervene when necessary".

In the case of a MASS with no master on board, especially degree three MASS (remotely controlled ship without seafarers on board), and degree four MASS (fully autonomous ship) it is necessary to clarify who, if anybody, would have to satisfy the role of the master. Considering that in these cases there is a Remote Operating Centre (ROC), the command, control, and monitoring of ships will take place from the ashore o afloat ROC, and in the absence of a master or crew on board.

In this regard, Regulation 2, e (i) of SOLAS Convention generally refers to the «master and the members of the crew or other persons employed or engaged in any capacity on board a ship on the business of that ship». He should be officially designated by the owner of the MASS as discharging the responsibilities of the Master of the MASS; he may be located anywhere, as long as he can ensure that an appropriate level of communication and control over the MASS can be maintained.

There is also the possibility that the master of a MASS is responsible for multiple MASS at the same time [38], but this should be ruled out in cases of emergency situations and navigation in congested areas or in locations where the marine environment is at risk. It has also been questioned whether several masters can be responsible sequentially for a MASS operation over a single voyage, but it has been underscored the importance of having only one master at any given time, and that further clarification is required as to the timing when handing over command takes place [39].

[38] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 5.

[39] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships

For other scholars, however, it is difficult to identify the characterizing elements of the figure of the master understood as "person having the command or charge of the vessel for the time being" in the case of a master of a MASS. In this case, it would be preferable that the owners or operators of a MASS be required by law to nominate a person to fulfil the statutory role of "master", to whom notices required to be sent to the "master" can be communicated [40]. In other words, "There is a need for legislative intervention (i) to state that, for the purposes of the Salvage Convention, where a ship is uncrewed or under RCC control the term 'master' shall include the person from time to time in control of her at a relevant control station; and (ii) to make it clear that operations carried out entirely on land may in a suitable case be classified as salvage" [41].

Moving on to the other professional figures involved in the management of a ship, the concept of crew must also be considered, which also operates remotely in degrees three and four of autonomy. Especially, the concept of crew of a MASS should consider either "remote crew" and "onboard crew".

In a MASS, the figures of the following are highlighted, as involved in the responsibility for the MASS activity: the Shipowner, "the subject who owns or operates a ship, whether a person, a corporation or other legal entity, and any person acting on behalf of the Owner or Operator"; the Oper-

(MASS) on its second session 107/5/1, p. 5. At the end the Group agreed that several masters may be responsible for a MASS on a single voyage, under certain conditions, and that only one master should be responsible at any given time. Regarding the master's competences and Responsibilities, the Group also agreed that the required qualification should be based on the STCW Convention and Code, and that additional requirements or modifications of the requirements of the STCW Convention may be necessary, depending on the roles of the master and crew of a MASS that will be identified. In addition, the Group agreed that the applicability of the Maritime Labour Convention (MLC) to the master and crew of a MASS would need to be considered at the appropriate forums.

[40] B. Soyer, A. Tettenborn, G. Leloudas, *Remote controlled and Autonomous Shipping: UK based case study*, p. 11. For the Authors "It should be provided in law that, in the case of a MASS, any legal penalty or liability attaching to the "master" should attach to the above person, and should also attach to the registered owner of the vessel. This could be done by a general legislative provision stating that wherever effective control of a vessel was being exercised by a person not on board, then any legal penalty or liability arising under any enactment should, unless the context required otherwise, attach to that person".

[41] B. Soyer, A. Tettenborn, G. Leloudas, *Remote controlled and Autonomous Shipping: UK based case study*, p. 39.

ator, i.e., "An entity (e.g. a company) that discharges the responsibilities necessary to maintain the MASS in a seaworthy condition and compliant with all relevant IMO Instruments and national legislation. The operator is also responsible for ensuring that all staff concerned with the control of MASS hold appropriate qualifications as required by IMO instruments and national legislation"; the MASS Watch Officer, intended as "the individual who has responsibility for the MASS when it is operational", and the Ship Security Officer, which is "a person accountable to the master, designated by the Company as responsible for the security of the ship, including implementation and maintenance of the ship security plan and for liaison with the company security officer and port facility security officers" [42].

10. – In general terms «The master shall have the authority to conclude contracts for salvage operations on behalf of the owner of the vessel. The master or the owner of the vessel shall have the authority to conclude such contracts on behalf of the owner of the property on board the vessel» (art. 6.2). For MASS with third or fourth degree of autonomy, without crew or master on board, we believe that also the shipowner or other shipping agents ashore can conclude the salvage contract [43], since nowadays the reception of instructions and communications from the ground is instantaneous.

However, the perception of the dangerous situation can be somewhat distorted in the assumption that the master is not on board the ship: in this case, either the salvor and the salved vessel, her master and shipowner are distant from the danger and from the perception of it and they must examine the existence and degree of danger via the Communication System to the remote location. The degree of perception is unlikely to be the same as that of a master on board the ship.

11. – Under Art.19 of the Salvage Convention "Services rendered notwithstanding the express and reasonable prohibition of the owner or master

[42] Maritime UK, *Maritime Autonomous Ship Systems (MASS) UK Industry Conduct Principles and Code of Practice - A Voluntary Code*, Version 6, 2022.

[43] A separate case is represented by the hypothesis that for some reason the communication between ROC and MASS is interrupted, and, in this case, it is doubtful that the MASS can have an autonomous authority to conclude the contract, given that it is believed that a machine cannot have the full capacity to act and to carry out legally binding acts.

of the vessel or the owner of any other property in danger which is not and has not been on board the vessel shall not give rise to payment under this Convention".

Even in this hypothesis, we must consider that in a MASS the master and the crew may not be on board, and it may be more difficult to prohibit a salvage operation due to more limited communication facilities. In addition, it may happen that the salvor considers that the salvage should be carried out, while the remote operator, which is on the ROC and not on the scene of the danger is unable to assess. In this case, the problem of the vulnerability of the crewless MASS should be addressed.

As indicated above, there may be the hypothesis of a salvage operation spontaneously rendered by a hacker, who blocks the harmful effects of an act of piracy on the MASS management software or its communication system.

In this case, the express and reasonable prohibition of the owner or master of the vessel (art. 19 of London Conv.), may prevent the salvage reward.

12. – The master of a MASS, in degree three and four of autonomy is placed on the ROC. For the MSC-LEG-FAL Joint Working Group the "Remote Operations Centre means a location remote from the MASS that can operate some or all aspects of the functions of the MASS" [44]. In the identification of specific rules on the ROC, the Group also considers that "apart from an ROC that has overall control of the operation of MASS, it is possible to have a workstation controlling MASS within that ROC, which may also be set up on another ship; the interaction of MASS with Vessel Traffic Services (VTS) needs to be considered when defining an ROC; the Group should only look into the overarching high-level aspects relating to ROCs, as the technical work or further definition of relevant terms was a matter for MSC; reference to real-time control should be included in the definition; the definition of an ROC should not only relate to safety functions, but also to other functions such as the provision of cargo information; the definition should include text that clarifies that an ROC is 'under the effective jurisdiction of the flag State'; and an ROC is not to operate some systems but instead, some functions".

[44] MSC, *Development of a goal-based instrument for maritime autonomous surface ships (*MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 6.

We can, further, consider that a MASS may be operated from different ROCs during a single voyage. In this case, only a single ROC must be responsible for a MASS at any one time, and there should be further consideration on the conditions that may allow for the handover of responsibility for a MASS from one ROC to another ROC, and the issues that will arise when the ROC is located outside of the flag State of a MASS [45].

13. – The term "remote operator" includes a remote master and remote crew, and it is linked with an ROC [46].

Any other person not directly taking part in the operation of the MASS, e.g. persons undertaking marine research operations from MASS working at an ROC, should not be considered as remote operators.

The crew of the salving vessel is generally considered by the Salvage Convention in the generic meaning of "salvor and servants" for the purposes of the apportionment of the reward: pursuant to art. 15.2 , "the apportionment between the owner, master and other persons in the service of each salving vessel shall be determined by the law of the flag of that vessel. If the salvage has not been carried out from a vessel, the apportionment shall be determined by the law governing the contract between the salvor and his servants".

In a general sense, the remote operator is "a qualified person who is employed or engaged to operate some or all aspects of the functions of a MASS from a Remote Operations Centre". The same operator can therefore be assigned tasks related to the remote assistance operation.

14. – There are many examples of salvage operations in commercial transport are the cases of salvage of passengers from a fire, towage of the ship with passengers on board to a safe port, assistance to passengers on the ship by providing food or other supplies. In these cases, the master, either of container vessels or bulk carriers, tankers, cruise liners or fishing vessels, has the

[45] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 6.

[46] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 7.

same obligation to assist people in danger at sea [47].

In all the mentioned hypotheses, large-scale salvages with commercial ships can be costly and dangerous for the salvors in terms of increased direct costs, such as extra fuel consumed, port charged assessed during disembarkation of salved people, additional wages or repairing or cleaning the vessel, as well as in terms of indirect costs, such as the delay, if the vessel is obliged to deviate from its intended voyage, to embark rescued persons, up to the final destination to a safe port.

The use of MASS in a salvage operation can be a possible answer to the need to limit the danger for the crew employed in the salvage operation, and a part of the costs of the salvage activity.

15. – Under rule 33 of the SOLAS Convention "The master of a ship at sea which is in a position to be able to provide assistance, on receiving a signal from any source that persons are in distress at sea, is bound to proceed with all speed to their assistance,", thereby giving the master the possibility of evaluation of the most appropriate conduct to follow.

Under Art. 98 of the Montego Bay Convention, the State shall require the master of a ship flying its flag to render assistance to any person found in danger at sea, if there is no serious danger for the ship, the crew and passengers, or to proceed with all possible speed to the rescue of persons in distress in so far as such action may reasonably be expected of him.

Article 10 Salvage Convention states 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». However, we have to ask ourselves whether this provision also applies to MASS, especially the three and four degree of autonomy ones.

Generally, MASS is not designed to host people on board and its capability to render assistance is limited.

[47] On this topic, referred to the US legal system see most recently J. Coito, *Maritime Autonomous Surface Ships: New Possibilities—and Challenges—* in Ocean Law and Policy, 97, Int'l L. Stud., 2021, 259 ss., p. 264. For the Author "Indeed, it is the master at sea that heretofore has been the "eyes and ears of the global SAR system." This duty applies in like manner to commanding officers of warships of the U.S. Navy and Coast Guard. This conclusion leads ineluctably to the pivotal question of who, if anyone, is the "master" of a MASS? And if there is no "master" of a MASS, can the legal duty to render assistance—the thrust of which falls upon the master—continue to exist?".

In this regard, safety spaces and safety devices could be foreseen to provide hospitality to people rescued by the mass.

To achieve such a capability, an initial predisposition by design would be necessary and the provision of an obligation on the part of the flag state to indicate ship construction standards to guarantee assistance to people in distress.

The shore-based operator should make his best endeavours to request assistance from ships that are in the proximality of the one to be assisted, send out a distress signal, or inform the competent authorities that a ship is in danger.

A MASS should be equipped with suitable instrumentation to provide assistance to persons in distress to the extent that such behaviour can reasonably be expected from it. Moreover, a MASS should be able to identify and locate distress signals ad communicate with ROC.

There are still some critical aspects to be clarified: should the MASS's technical capabilities define the nature and the requirements of the duty to render assistance or vice versa? From this point of view, it was anticipated, in the preceding paragraphs, that, with reference to the functions of Search and Rescue, the draft of the MASS Code clarifies that "Every MASS should be able to provide assistance to persons in distress at sea as far as such action may reasonably be expected of it" [48].

To do this, the MASS should also be suitably equipped to deal with the hypothesis of having to accommodate rescued people on board. This can pose problems of increased costs and changes to the design of considerable criticality for shipyards and for shipowners who want to purchase a MASS.

We think that the provision of salvage equipment suitable to assist people in danger should be accompanied by economic support measures or tax benefit in the preparation by design of the instruments necessary to arrange a permanent state of readiness of the MASS, just as we believe that the crew, whether on board, ashore or on the ROC, should be adequately trained to conduct salvage operations with a MASS.

[48] IMO Maritime Safety Committee, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the Correspondence Group Submitted by Marshall Islands, 108th session, Agenda item 4, MSC 108/4 13 February 2024, p. 50.

16. – Article 2 of the Salvage Convention states that "This Convention shall apply whenever judicial or arbitral proceedings relating to matters dealt with in this Convention are brought in a State Party". In this way, the salvage convention applies as *lex fori*.

However, the identification of the jurisdiction may be more difficult where the salvage operation is rendered by a ROC, plausibly located in a completely different location than the one where the assistance operation occurs. In fact, the applicability of national laws is predominantly determined by the geographical position and use of the MASS, and the location of ROC may give rise to complex legal issues on jurisdiction and the responsibility of the flag State, in particular the concurrence of the territorial jurisdiction of the State in which the ROC is located and flag State jurisdiction.

Under art. article 92 1 UNCLOS 1982, the flag state has only exclusive jurisdiction over ships that sail under the flag of that state on the high seas and only a MASS that is registered as a ship will fall under the jurisdiction of the chosen flag state.

A jurisdictional issue could arise for the ROC, which can be ashore or afloat, and controls MASS from a separate country to the location of the ship.

The MSC-LEG-FAL Joint Working Group has recently argued that the definition of ROC should include text that clarifies that an ROC is under the effective jurisdiction of the flag State.

The Group agreed that "exercising of effective flag State jurisdiction and control is of paramount importance, consistent with article 94 of UNCLOS and that it may be necessary to establish a *genuine link* in a situation where an ROC is located in a place other than the flag State of a MASS" [49].

In relation to the "genuine link" requirement one delegation proposed that the "genuine link" required under article 91 of UNCLOS between the flag State and the ship, where the ROC is located outside the jurisdiction of the flag State, could be addressed by establishing a "contractual link" between the ship, the shipowner/ship operator, and the ROC, according to a practice which is well-established in merchant shipping, to include a contractual clause dealing with the proposed jurisdiction and proper law of the contract in the

[49] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 9.

event of any dispute between the relevant parties: "This approach may address the challenge posed for a flag State in permitting an ROC to operate one or more of its MASS outside the jurisdiction of the said flag State, under UNCLOS as the "umbrella treaty" and under customary international maritime law for those flag States who have not ratified UNCLOS; while others delegations observed that articles 91 and 94 of UNCLOS require a high degree of responsibility from the flag Stat and Remote Operations Centres situated outside the territory of the flag State would create insurmountable legal challenges in light of UNCLOS and general international law, and that such responsibility cannot be replaced by a contractual link" [50].

[50] MSC, *Development of a goal-based instrument for maritime autonomous surface ships* (MASS), Report of the MSC-LEG-FAL Joint Working Group on Maritime Autonomous Surface Ships (MASS) on its second session 107/5/1, p. 10.

Abstract

Il soccorso marittimo è uno dei settori in cui sono maggiormente impiegati i *Maritime Autonomus Surface Ship* (MASS) ed in cui si prevedono importanti sviluppi in termini di automazione delle relative attività. Nel contempo, vi è un crescente impegno a trovare un equilibrio tra i benefici derivanti dalle nuove tecnologie e dall'impiego dell'intelligenza artificiale e le preoccupazioni in materia di sicurezza marittima, compresa la cibersicurezza, con i costi e l'impatto sul lavoro e con la sostenibilità ambientale. Risulta ormai chiaro che l'obiettivo finale delle navi autonome sarà la totale sostituzione dei marittimi con software di bordo che consentano un minor numero di incidenti causati da errore umano, soprattutto in ambienti ostili dove è richiesta assistenza per uomini, cose e imbarcazioni nell'ambiente acquatico. Tutto ciò ha chiari riflessi sul regime giuridico applicabile, anche in considerazione della futura adozione in ambito internazionale di un Codice MASS che identifica il ruolo di un *Remote Operation Centre* (ROC) ed interviene a ridisegnare le funzioni del Remote Master. Il presente scritto si propone di analizzare i concetti menzionati, anche al fine di integrarli nel quadro normativo attuale di riferimento del settore.

Maritime Salvage is one of the sectors in which Maritime Autonomous Surface Ships (MASS) are most widely used, and in which important developments are expected in terms of automation of the related activities. At the same time, there is a growing commitment to balance the benefits of new technologies and the use of artificial intelligence with maritime security concerns, including cybersecurity, with costs and impacts on labour and environmental sustainability. It is now clear that the ultimate goal of autonomous ships will be the total replacement of seafarers with on-board software that allows fewer accidents caused by human error, especially in hostile environments where assistance is required for people, things and vessels in the aquatic environment. All this has clear repercussions on the applicable legal regime, also in consideration of the future international adoption of a MASS Code that identifies the role of a Remote Operation Centre (ROC) and intervenes to redesign the functions of the Remote Master. This paper aims to analyse the concepts mentioned, also in order to integrate them into the current regulatory framework of reference in the sector.