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Igor Vio
E-mail: igor.vio@pfri.uniri.hr
University of Rijeka, Faculty of Maritime Studies, Studentska 2, 51000 Rijeka, Croatia
Mate Brdar
E-mail: matezd.brdar@gmail.com
Paklenička 16, 23000 Zadar, Croatia

Maritime Autonomous Surface Ships – International and National Legal Framework

Abstract

The use of autonomous ships in shipping industry is increasingly being analysed and occupies the maritime sector. In the maritime industry, the introduction of autonomous underwater crafts began first this trend, after which the development of autonomous surface ships has followed. Unmanned vessels include ships operated remotely by an operator on land and autonomous ships that are fully operated by the computer programmes and only in exceptional situations the ship's crewmembers or other human resources may be involved. The commercial application of these facilities is becoming more and more certain and this topic is increasingly being discussed. This trend obviously poses a huge challenge to all maritime actors, as well as lawmakers at international and national level. Namely, although the current development of maritime law has effectively regulated most of new technologies, all these standards and regulations have been adapted for the use of the conventional manned ships. A number of questions concerning the possible change in international and national regulations regarding the implementation of autonomous ships have been raised. It is considered as a priority within the framework of IMO unification instruments and changes in the Maritime Code of the Republic of Croatia. This paper presents various legal aspects of the use of autonomous ships with the aim to define the autonomous ship and to examine how present international conventions and national regulations could adapt to provide the legal framework to the introduction of autonomous ships.

Keywords: autonomous surface ships, autonomous systems, unmanned vessels, maritime legislation

1. Introduction

Development of autonomous and remotely controlled ships is advancing rapidly. This has been made possible by the recent enhancement of sensor technology, offshore connectivity and software to analyse and support decision-making and algorithms, so that the first commercial projects are ready for launching. The area is wide, with many different applications and concepts of automation that could benefit the maritime

industry. From fully unmanned ships to remotely operated vessels and from virtual bridges on land to support systems that alert crew before a collision or help optimize operations.

The implementation of autonomous ships will have an impact on all aspects of the shipping industry. It implies the economic improvement of the company activities because it contributes to increasing profits, reducing environmental pollution and eliminating the number of maritime accidents. The main motive for the development of an unmanned and autonomous ship is to contribute to the goal of a more sustainable maritime transport industry. This industry faces the task of defining and understanding the concept of autonomous ships, as well as developing related legal framework comprised of international and national regulations. This requires analysis and research of the general concept of autonomous ships, its goals and possibilities for the realization. The first goal is to define the autonomy of the ship, the way the autonomous ship functions, the related legal regime, the way of running an autonomous ship through a coastal control centre, operational procedures related to the autonomy of the ship and the presentation of the project engaged in these investigations. Therefore, it is necessary to describe the autonomous ship, examine existing relevant projects and the related operational, regulatory and qualitative challenges posed due to the development and actual application of such vessels in the near future.

The emergence of an autonomous vessel is the subject of a series of discussions, which have occurred due to the strong and accelerated development of technology. Maritime trade volumes are expected to increase in the future and the number of ships needed to transport cargo will increase accordingly, as well as the number of seafarers needed to operate the ships. At the same time, European shipping today is facing a shortage of naval personnel. The reason often stated for this lies in the unattractiveness of maritime occupations, especially for young people. To some extent, this is caused by the inherent problem of seafaring resulting with the absence of private life and the limited possibility of spending time with the family, as well as and the high degree of isolation from social life that comes together with work on a merchant ship. The current trend of slow sailing speeds, which are justified by environmental and economic reasons, increases the length of navigation of the ship, and therefore the time spent by seafarers at sea. The longer period on-board caused by the difficulties in international travel and change of crewmembers because of the COVID-19 pandemic have represented an additional problem.

2. Concept and Definition of Autonomous Ship

The European Technology Platform describes the autonomous ship as the next generation of modular management and communication technologies that will enable wireless monitoring and control functions on and off the ship. This will include advanced decision support systems that will enable remote control of ships by partially or fully

autonomous control.[1] The most imposing achievement in terms of the production of autonomous ships has been achieved so far by Rolls-Royce Holdings, which created a prototype autonomous ship in virtual reality in 2014. When these projects are completed, a human crew will initially be applied to oversee operations on board, however the intention is to evolve an unconditionally autonomous system over time so that the ships will not need human resources, but computers and artificial intelligence should perform surveillance over the ship. The test of an autonomous container ship began in 2017. Such a ship had stacked containers from the bow all the way to the stern. The concept of the ship is such that its total mass will be five percent lighter before loading cargo and it will consume twelve percent to fifteen percent less fuel.[2]

The autonomous ship can be remotely operated from the coastal area by a control centre where all information related to the route and ship may be retrieved. Monitoring and management functions outside defined boundaries are performed by an onshore operator at the Coast Control Centre.[3] The entire management is to be supported by modern available technology, including satellite-based equipment on which all information is obtained in real time, thus creating symbiosis of computer and remote control. It is evident that sensors ship handling simulation, engine control and monitoring system, remote control system and control coastal centre play an important role in this management.

An advanced sensor module that takes care of the duties on the on-board monitoring centre by continuously connecting sensor data from existing navigation systems, e.g. radar and AIS, combined with modern day and infrared cameras. There is a significant autonomous navigation system that follows a predefined itinerary, but with a certain degree of freedom to adapt the route in accordance with the requirements. In addition, the role of an autonomous engine control and monitoring system establishes automation systems with certain malfunction prediction functionalities while maintaining optimality and taking care of the additionally installed pump jet that acts as the rudder. The Land Management Centre continuously monitors and controls autonomously operated ships by skilled naval officers and engineers.[4]

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1 European Commission, (2012) Maritime Unmanned Navigation through Intelligence in Networks, at: http://www.unmanned-ship.org/munin/wp-content/uploads/2015/10/MUNIN-D9-3-Quantitative-assessment-CML-final.pdf [Accessed on 7 April 2022].

2 Rolls Royce (2016) Ship Intelligence Transforming Future Marine Operations, available at: http://folk.uio.no/eriktol/Presentasjoner_2016/2009_12.50_Mikael_Makinen.pdf, [Accessed on 24 March 2022].

3 Bruhn, W.C., Burmeister, H.C. (2013) Process Map for Autonomous Navigation, see more at: www.unmanned-ship.org [Accessed on 20 April 2022].

4 Burmeister, H. C., Bruhn, W., Rødseth, J., Porathe T. (2014) Autonomous Unmanned Merchant Vessel and its Contribution towards the e-Navigation Implementation: The MUNIN Perspective, International Journal of e-Navigation and Maritime Economy 1 (2014), at p. 7, https://www.researchgate.net/publication/AutonomousUnmanned_Merchant_ Vessel_and_its_Contribution_towards_the_e-Navigation_Implementation_The_MUNIN_Perspective, [Accessed on 24 March 2022].

IMO has recognized the importance of creating the international legal regime for these vessels and has been using the term "*maritime autonomous surface ships*" (*MASS*) in all the official materials, in which four various degrees of autonomy were considered: crewed ship with automated processes and decision support (degree one); remotely controlled ship with seafarers on board (degree two); remotely controlled ship without seafarers on board (degree three); and fully autonomous ship (degree four).[5]

3. International Maritime Law and Law of the Sea

The internationally agreed regime, which has been an important tool for harmonising safety and security since 1982, has contributed to reducing human factor errors (usually present on-board ships due to poor judgment, stress, inadequate staff, poor living conditions, fatigue, etc.), improving training, safety, environmental awareness and communication between multicultural and multilingual crews and port control, has also contributed to safety and security in the maritime industry.[6]

There is no single definition of the concept of ship or vessel at international level. International conventions laying down standards of navigation safety, protection of human lives at sea, prevention of marine pollution, as well as a number of maritime, property law conventions, depending on the issues they regulate and the purpose they wish to achieve, use separate definitions of the term ship or vessel. These definitions apply exclusively for the implementation of a particular instrument. Accordingly, conventions that normalize navigation safety standards very often determine the concept of a ship or a vessel by including a wide number of navigable objects used at sea, although it is evident that they are not vessels.[7]

According to those definitions, it can be established that they essentially may be related to autonomous ships. It can be noted that unmanned ships do not lose the characteristics and determinants of the ship. Whether they will have and possess the legal status of a ship or other craft depends on the conditions regulated by the national legislation of the state whose nationality such an object seeks to achieve.[8] By achieving the legal status of the ship and the nationality of a particular flag state, the autonomous ship will have the right to sail like other conventional ships, but will also be exposed to a number of international standards and rules, so that some authors wonder if and

5 IMO MSC, Autonomous Ships: Regulatory Scoping Exercise Completed, avaiable at: https://imo.org/en/MediaCentre/PressBriefings/pages/MASSRSE2021.aspx, [Accessed on 25 May 2022].

6 See: Chircop A. (2017) Testing International Legal Regimes: The Advent of Automated Commercial Vessels, German Yearbook of International Law, Vol. 60, pp. 110-143.

7 Ćorić D., Pajković, M. (2018) Autonomni brod - nova vrsta broda u pomorskom zakonodavstvu, Suvremeni izazovi pomorske plovidbe / Amižić Jelovčić Petra (ed.). Split: Pravni fakultet u Splitu, p. 109.

8 Ćorić D., Pajković, M., op. cit., at p. 111.

how autonomous ships will meet the aforementioned standards, originally adopted for conventional ships, and even more important, if these ships will be able to fulfil their primary purpose – safety of navigation.[9] The answer to this question will be formulated by the IMO and other working groups dedicated to the issue of autonomous ships and the legal barriers to their inclusion in international maritime transport. It is possible that the different legal regulations will be adopted for those remotely operated ships and for those fully autonomous. Over the last years, the IMO has completed a regulatory scoping exercise in order to establish which the future steps will be in creating legal framework for autonomous shipping [10]

It is clear that in accordance with the meaning and understanding of the concept of the ship in the majority of national legislations, but also within the framework of international regulation, there is no obstacle for autonomous ships to be considered ships in order to be able to carry out navigation.[11] However, they should have the state affiliation of a particular state like conventional ships. The nationality of the ship implies the first step of individualization of the ship and marks its exposure to the legal regime of the flag state, but also to the coastal or port state jurisdiction.

3.1. United Nations Convention on the Law of the Sea (UNCLOS 1982)

The 1982 United Nations Convention on the Law of the Sea, which regulates the duties of flag states and port states, does not define the concept of ship.[12] Pursuant to Art. 91. of the UN Convention on the Law of the Sea (UNCLOS 1982) each individual state defines the conditions for ships of acquire its nationality, as well as of course the conditions of registration in state registers and the right to fly its own flag.[13] The 1982 Convention requires the so-called genuine link between the ship and the flag state to exist. In order to achieve the above conditions, flag states should, when registering a ship in the national register, request that the shipowner is a citizen of that state or, in the case of a legal entity that he is based in a particular country or that the ship operator's seat is in that country if the ship operator is not also a shipowner. The aforementioned condition will not be a problem in the case of possible registration of an autonomous ship in any national register, as they will also have their shipowners and/or ship operators, understandably provided that the specific object achieves all the components required by the relevant legislation to achieve the status of the ship. Next, the flag states have established functions of supervision in relation to the ships to which

9 Ibid.

10 IMO MSC, Autonomous Ships: Regulatory Scoping Exercise Completed, loc. cit.

11 See more: Gahlen S.F. (2014) Ship revisited: a comparative study, Journal of International Maritime Law, Vol. 20, pp. 252 – 303.

12 United Nations Convention on the Law of the Sea, Official Gazette – International Agreements, No. 11/1995 and 9/2000.

13 Ćorić D., Pajković, M., op. cit., p. 110.

they have given their nationality. The provisions of UNCLOS 1982 prescribe that each state exercises its own jurisdiction effectively and supervises ships that fly its flag in accordance with administrative, technical and social issues.[14]

It can be emphasized that each State, for ships flying its flag, shall carry out the necessary measures with a view to exercising safety at sea, *inter alia*, with regard to: construction and equipment of the ship and its navigation capabilities, systems, working conditions and crew training, taking into account applicable international standards, use of signals, maintaining connections and preventing collisions.[15] These measures also integrate, *inter alia,* those necessary with the aim of securing the ship under the duress of the ship's commanders and officers who possess the appropriate qualification, in particular for the operation of the ship, navigation, connections, and that the crew corresponds to the model, the dimension of the ship according to their own training and number. Certainly, the issue of autonomous ships' access to foreign ports open to international traffic should also be addressed and regulated. This issue has been covered a century ago by the Convention on the International Regime of Sea Ports, with the Statute, adopted in Geneva in 1923, when nobody could imagine the future existence of unmanned ships.[16]

3.2. International Convention for the Safety of Life at Sea (SOLAS, 1974/88)

The SOLAS Convention does not contain the definition of a ship, but contains definitions of certain types of ships as well as the concepts of a new ship and an existing ship.[17] SOLAS prescribes minimum standards for the construction, safety equipment and necessary ship certificates. Responsibility for compliance shall be given to the flag state where the vessel is registered, with the right to inspect foreign ships visiting their ports through the system of port state control. After the sinking of the Titanic, SOLAS was adopted by a diplomatic conference convened by the British government in 1914 and was supplemented repeatedly to the latest version. States Parties to SOLAS, once they have signed and ratified the Convention must comply with its provisions and verify that all ships of their nationality meet the requirements of SOLAS.[18]

14 UNCLOS 1982, Art. 94.

15 Ibid., Art 94 (2).

16 Convention on the International Regime of Sea Ports, with the Statute (Geneva, 1923.), Official Gazette - International Treaties No. 1/1992.

17 International Convention for the Safety of Life at Sea (SOLAS, 1974/88), Official Gazette - International Treaties No. 1/1992.

18 The International Convention for the Safety of Life at Sea, 1974 (SOLAS) was adopted by the International Maritime Organisation in 1974, and the SOLAS Protocol was subsequently adopted in 1978. The Republic of Croatia is a party to the Convention and the Protocol of 1978 on the basis of notification of succession and for our country the Convention and Protocol are in force since 8 October 1991 (Decision on the publication of multilateral international agreements to which the Republic of Croatia is a party on the basis of notification of succession, Official

When the conditions are met, a certificate of compliance is issued. In case that the ship or its equipment violates (or is suspected of having violated) these requirements, the competent port state control officers shall have the right to inspect the ship when entering the PSC's area of responsibility.[19]

The autonomous vessel is not excluded from Chapter I, therefore the terms 'must be sufficiently and efficiently crewed' and 'must have an appropriate document on the minimum number of crew members or equivalent', meaning that those requirements must be met, otherwise the rule must be adapted to reflect the new reality of the unmanned ship without crew on board.

3.3. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW 1978)

The STCW Convention was adopted in 1978 and amended in 1995 and 2010.[20] Today it applies to seafarers on board but not to personnel responsible for operating an autonomous ship from a remote control centre located on land nor the computer engineers who create software and hardware enabling autonomous navigation. These professionals are *de facto* taking over the role of the ship's master and officers in control of the navigation but are not subject to the rules of the STCW.[21]

In addition, according to UNCLOS, flag States shall ensure that each ship is 'in charge of the master holding the appropriate qualifications, in particular in maritime affairs, navigation, communications and marine engineering'.[22] As some authors argue, the obvious question is whether it is possible for an unmanned ship, by its definition, to have a master.[23] Furthermore, the contribution of work for onshore staff

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Gazette – International Treaties No. 1/1992). The Second SOLAS Protocol, adopted by the IMO in 1988, entered into force for the Republic of Croatia on 30 April 2000 (Decree on Accession to the Protocol of 1988, Official Gazette – International Treaties No. 13/1999 and Decision on Entry into Force of the Protocol, Official Gazette – International Treaties No. 4/2000).

19 One of the most important issues that could challenge the very essence of the autonomous ship is Chapter V. Rule 14 of SOLAS regarding the manning of ships with crew. The second is Rule 33 (Exceptional Situations: Obligations and Procedures) of the same Chapter, which will be analysed below in part 3.5. analysing maritime search and rescue operations.

20 International Convention on Standards on Training, Certification and Watchkeeping of Sea-farers, 1978 with Resolutions (STCW 1978/95). Official Gazette - International Treaties No. 1/1992

21 The International Convention on Standards on Training, Certification and Watchkeeping of Seafarers (STCW) which was adopted in London on 7 July 1978 and entered into force in 1984, has in the meantime undergone changes and amendments three times: in 1991 the amendments relating to GMDSS were adopted, in 1994 additional regulations on special training of the crew on board tankers were brought, while the most comprehensive modifications were adopted at the Conference which took place in London from 26 June to 7 July1995.

22 UNCLOS 1982, Art. 94. (4) (b)

23 Veal R., Tsimplis M. (2017) The Integration of Unmanned Ships into The Lex Maritima, Lloyd′s Maritime and Commercial Law Quarterly, at p. 331, available at: https://eprints.soton.ac.uk/411256/ [Accessed on 22 April 2022].

at the remote control centre is expected to be significant. "Master on land" with the help of one to three operators can simultaneously control a small fleet of autonomous vessels. The minimum number of such vessels permitted to operate at once has not yet been set. However, whereas the rules of labour law would apply to remote control centre operators or developers of a fully autonomous ship, specific rules similar to those applicable to seafarers (such as the duty to report distressed signals, etc.) may also need to be adapted and applied. With a view to reaching an agreement for persons working on positions of remote ship control from coastal centers to gain legal status of a conventional crewmember (master or deck officer), legislative intervention should be less complicated. However, if the personnel of a control centre would not be considered for conventional seafarers, a number of questions and problems will arise and legislative intervention will be much more demanding.

3.4. Convention on International Regulations for Preventing Collisions at Sea (COLREG 1972)

The Convention on International Regulations for Preventing Collisions at Sea (COLREG), which was adopted in 1972 and entered into force in 1977, revised the International Rules for the Prevention of Collisions at Sea of 1960, and defined, *inter alia*, the rules of navigation (the so-called "Rules of the Road") followed by ships and other vessels at sea to prevent collisions between two or more vessels.[24]

COLREG shall apply to all vessels on the high seas and in all waters connected to them.[25] This formulation includes as well the autonomous vessels and according to the rule with general definitions, the word "vessel" includes every description of watercraft, including non-displacement craft, WIG craft and seaplanes,[26] used or capable of being used as a means of transportation on water. Although this definition does not include an autonomous vessel, it neither precludes it from being characterised as a 'vessel'.

Having in mind that all the previous versions and the current edition of the Collision Regulations were created for vessels with master and crew, it is quite natural that a variety of amendments should be introduced to all those rules that contain references to human senses of vision and hearing, as well as human behaviour that is result of rational decision making like "precaution which may be required by the ordinary practice of seamen",[27] duty of maintenance of a proper look-out,[28] "determining if risk of collision

[24] Convention on the International Regulations for Preventing Collisions at Sea (COLREG, 1972). Official Gazette - International Treaties No. 1/1992.

[25] COLREG 1972, Rule 1.

[26] COLREG 1972, Rule 3 (m) defines this term: "Wing-In-Ground (WIG) craft" means a multimodal craft which, in its main operational mode, flies in close proximity to the surface by utilizing surface-effect action

[27] COLREG 1972, Rule 2.

[28] COLREG 1972, Rule 5.

exists",[29] "action to avoid collision made in ample time and with due regard to the observance of good seamanship",[30] the execution of the last moment 'manoeuvre in the agony of collision' and conduct in restricted visibility.[31]

These changes should include all the technical instruments applicable in autonomous vessels like monitoring devices, radars, electronic sensors, cameras, microphones etc. that are replacing human audio-visual perception, with the task to enable personnel in remote control centers or vessels own artificial intelligence to process relevant information and produce optimal decisions in order to prevent and avoid collisions at sea.[32]

3.5. International Convention on Maritime Search and Rescue (SAR, 1979)

The International Convention on Search and Rescue at Sea (SAR) was adopted in 1979 with the aim to develop the International SAR Plan.[33] The rescue of persons in distress at sea is coordinated by the national SAR organisations and cooperation between neighbouring SAR organisations where necessary. The obligation of ships to assist ships in distress previously existed in both tradition and international treaties such as SOLAS. The adoption of the SAR Convention created an international system covering search and rescue operations globally. The SAR and the Guidelines for the Treatment of Persons Rescued at Sea include manned vessels and contain no mention of autonomous vessels.[34] SAR Regulation 3.1.9 applies in particular to the master of the vessel,[35] while UNCLOS 1982 in its provision titled "The duty to provide assistance" requires that each State 'require the master of a ship flying its flag, if it can provide assistance to any person in perilous danger at sea without serious danger to the ship, crew or passengers: (a) provide assistance to any person in perilous danger at sea; (b) continue actions in the shortest possible time to rescue people in distress; (c) after the collision, assist another ship, its crew and passengers.[36] This obviously creates a problem since the entire system is based on manned ships and it is a task for all the stakeholders to discuss the potential future inclusion of autonomous vessels in search and rescue operations.

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29 COLREG 1972, Rule 7.

30 COLREG 1972, Rule 8.

31 COLREG 1972, Rules 17. and 19.

32 H.-Ch. Burmeister, W. C. Bruhn, Ø. J. Rødsethb, T. Porathec, (2014) Can unmanned ships improve navigational safety?, Proceedings of the Transport Research Arena, TRA 2014, Paris, 2014, p. 6.

33 International Convention on Maritime Search and Rescue (SAR, 1979) Official Gazette - International Treaties No. 14/1996.

34 Resolution MSC.167 (78) was adopted on 20 May 2004.

35 SAR Convention, Regulation 3.1.9.

36 United Nations Convention on the Law of the Sea, Article 98 (1), Official Gazette – International Agreements, No. 11/1995 and 9/2000.

4. National Regulations

National maritime legislation of the majority of states has not yet sufficiently covered the autonomous vessels, and the reason lies in the recent development of this technology and the emerging new concepts of unmanned and fully autonomous ships. However, the issue of the use of such types of ships in international and national maritime transport is evident. In accordance with Croatian regulations and legal basis, the crew of the ship does not represent an important element of the concept of the ship, so autonomous ships can obtain the legal status of the ship if they meet various other conditions. This will be subject to a maritime law regime relating to all conventional ships that will need to be properly modified and completed.

4.1. Monitoring and Management of Maritime Traffic

The supervision and management of maritime transport is carried out with the aim of increasing the safety of maritime navigation, the efficiency of maritime transport and the protection of the marine environment.[37] Maritime Traffic Control and Management (VTMIS) encompass collection of data on maritime facilities and maritime transport, providing data to maritime facilities, providing navigation advice and support in navigation to maritime facilities, organization of navigation and management of maritime transport, supervision of the safety of navigation in accordance with the provisions of the Maritime Code and relevant EU rules and regulations.[38]

The supervision and management of maritime traffic is performed through the cooperation of the competent services of the Ministry and the port authorities with maritime facilities that sail or are located in the field of supervision and management.[39] Accordingly, autonomous ships in the near future should be supervised by the Ministry of Maritime Affairs and the established state authorities, which carry out the surveillance procedure.[40] The area of control and management of maritime traffic includes internal waters, territorial sea and the exclusive economic zone of the Republic of Croatia.[41] The supervision and management of maritime traffic are carried out in accordance with international treaties, provisions of the Maritime Code and the relevant by-laws. The

[37] Pomorski zakonik (Maritime Code), Art. 75 a Par. 1., Official Gazette 181/04, 76/07, 146/08, 61/11, 56/13, 26/15, 17/19.

[38] The Croatian Vessel Traffic Monitoring and Information (CVTMIS) System in accordance with the requirements of the Directive 2002/59/EC establishing a Community vessel traffic monitoring and information system and repealing Council Directive 93/75/EEC.

[39] Art. 75. a, Para. 3. of the Maritime Code.

[40] Vio. I. (2020) Maritime Safety - Croatian Legal Framework. Maritime Safety in Europe – A Comparative Approach. Nawrot, J., Peplowska-Dabrowska, Z. (editors), Informa Law – Routledge. London. pp. 74-93

[41] Croatia proclaimed its exclusive economic zone on 5 February 2021 (Official Gazette 21/21).

manner and conditions for carrying out the supervision and management of maritime traffic are prescribed by the Minister by special regulations.

The maritime traffic control and management activities are performed by the Maritime Traffic Control and Management Service (MTCMS) of the Ministry and harbourmaster offices in cooperation with the port authorities, the company Plovput and the Croatian Hydrographic Institute.[42] The MTCM Service performs its tasks by using the Technical Maritime Traffic Monitoring and Management System (VTMIS), i.e. automatic ship identification devices and equipment (AIS) and/or radar devices and equipment and/or maritime radio-communication devices and equipment and/or electronic charts.[43] The Maritime Traffic Control and Management Service may request the cooperation and support of the Coast Guard of the Republic of Croatia, the police, and other operational surveillance bodies. The competence, organisation, tasks, manner of operation of the MTCMS, and the scientific work and cooperation with other bodies are regulated by a special by-law.[44]

With the eventual presence of autonomous ships in the Republic of Croatia, the national legislation should definitely be amended in order to regulate their usage and make their navigation as safe as possible. Particularly important would be to amend the provisions of the Code related to the seaworthiness of the vessels and the application of the CRS technical rules.[45]

4.2. Defining Autonomous Ships in Accordance with Croatian National Regulations

The Maritime Code provides definitions of various maritime objects, including vessels or crafts, floating facilities and fixed offshore facilities.[46] Maritime vessel can be a ship, warship, submarine, yacht or boat. The classification of maritime facilities is relevant for aspects of the application of the relevant maritime regulations. Ship is defined as a vessel intended for sea navigation, the length of which is more than 15 meters, or it is authorized to carry more than 12 passengers.[47] In accordance with its introductory provision, the Code shall establish and regulate the maritime and submarine areas of the Republic of Croatia, the safety of navigation in the internal waters and territorial sea of the Republic of Croatia, the protection and preservation of natural marine resources and the marine environment, the basic substantive legal relations regarding vessels, contractual and property relations relating to ships, registrations

42 Art. 75. b, Para. 1. of the Maritime Code.

43 Art. 75. b, Para. 2. of the Maritime Code

44 Maritime Code, Art. 75. b

45 Maritime Code, Art. 76.

46 Maritime Code, Art. 5.2.

47 Ibid.

of vessels, limitation of the shipowner's liability, enforcement and security measures on ships.[48] According to Maritime Code, unless otherwise specified, its provisions shall be applied to maritime vessels located or sailing in the internal waters or in the territorial sea of the Republic of Croatia.[49] This provision undoubtedly would include the application of the Code as well to the autonomous vessels. The provisions of maritime administrative law are intended to ensure that the safety of navigation is implemented on all seagoing vessels because they carry out the established activity at sea. In contrast, the application of special property law provisions is generally limited to ships and other navigable crafts, while floating and stationary offshore facilities in terms of property law are subject to the general mandatory legal regime.[50]

The Maritime Code in its 2019 amendments introduced the definition of the term autonomous vessel by the following provision "an autonomous vessel shall be a vessel which, depending on the degree of automation and the requirements for immediate control of the permanent service, may sail without a crew boarded or with a reduction in the number of crew members".[51]

Consequently, it is undoubtedly possible to add autonomous vessels to the concept of the seagoing vessels category as provided for in the Code, on condition that it meets the mentioned legally defined elements. The fact that such an object is unmanned, which does not affect the possibility of obtaining the status of a ship, since the crew of the ship does not constitute an integral and established element of the ship even under national law. Ships may be used for the performance of various tasks, as also identified in the Code, which states, in addition to the ship's definition, that the ship may be a passenger, cargo, technical craft, fishing, government ship or scientific research vessel.[52] However, it is understandable that there have been certain dilemmas on the possible reasons why Croatian national legislation provided just the definition of autonomous vessel without any other provisions about its construction, operation, safety, security, protection of the marine environment, or liability for damages caused by its use.[53] On the other hand, so far there are no shipping companies in the Republic of Croatia developing this technology with the intention of introducing such ships into national coastal shipping, whereas their inclusion in international shipping will eventually occur when the IMO has implemented the appropriate amendments to the current regulations.[54]

48 Maritime Code, Art. 1.1.

49 Maritime Code, Art. 1.2.

50 Ćorić D., Pajković, M., op. cit., p. 114.

51 Maritime Code, Art. 5.1.

52 Maritime Code, Art. 5.2.

53 Savić, I. (2021) Autonomous Vessels in Croatian Maritime Law, "Modern Challenges of Marine Navigation", Amižić – Jelovčić, Petra (editor), University of Split Faculty of Law, Split, at p. 256.

54 Ćorić D., Pajković, M., op. cit., p. 114.

5. Conclusions

The analysis of international and national regulations regarding the definition of the term ship shows that the fundamental characteristic of autonomous ships is their possibility of autonomous action, through remote control of the same and supervision by personnel from control centres on land, as well as on the possibility that the ship operates completely independently without human supervision.

By registering in the relevant national register, the autonomous ship, as well as other types of ships, would acquire the legal status of the ship and would be subject to all maritime law regulations. Since the existing international legal regime was designed for manned ships, certain amendments and modifications will be required primarily within the framework of IMO unification instruments. Based on the past practice of the IMO, the probable form would be introduction of the Maritime Autonomous Surface Ships Code as an additional chapter of SOLAS. The provisions of the 1982 UN Convention on the Law of the Sea regarding the duties of flag States and coastal States, as well as the legal status of such ships in the sea areas and ports of foreign states, will also need to be considered. The directions of possible changes will depend on the degree of autonomy and in the first phase, the legislative work will be directed primarily to remotely operated ships. The fundamental question will be to explain and regulate the operations of coastal control centres, as well as to define the status of human resources, and to answer the question of whether they could be considered the crewmembers of the ship in order to accept and apply their obligations and duties determined by the STCW and other IMO instruments.

The other set of dilemmas and questions is generated by the application of fully autonomous ships commanded by the computer programmes and artificial intelligence with no human resources control or with its activation only in exceptional situations that are predetermined and installed.

Autonomous ships have the potential to redefine the maritime industry and the role of participants in it with implications for shipping companies, shipbuilders and maritime systems. Since detailed testing concepts and technology assessments are currently being analysed using a ship management simulation, the proposed concepts represent a preliminary stage. Therefore, before carrying out separate e-navigation solutions from the proposed concepts, more final feasibility results should be expected before all the practical implications of autonomous shipping can be assessed. The research projects have to explore how to combine existing communication technologies in an optimal way for autonomous ship control, creating a simulated autonomous ship control system that will be connected to the satellite communication connection as well as land systems and will allow the entire communication system to be examined.

However, when it comes to new technologies, development of a broader and deeper understanding of a changed risk portfolio with a range of known and unknown hazards is top priority. Cyber security will also be crucial for the safe and successful operation of remote and autonomous vessels. The future regulatory approach should identify,

include and adapt current best practices from a range of industries for application in the marine environment.

With the understanding that the actual legal regulation is set for manned ships, it will be necessary to carry out the necessary refinements and changes, as a matter of priority under the IMO unification instruments. There is no doubt that there are challenges that autonomous ships and their inclusion in maritime transport pose to international and national legislators to be effectively resolved. The amendments should first concern the remote controlled ships and then the fully autonomous ones. A fundamental issue will be to analyse and regulate the operations of coastal control centres and human resources status. Maritime law has always evolved simultaneously with technological developments so it is to expect that it will provide legal solutions for all the emerging issues created by the introduction of maritime autonomous surface ships.

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