ISSN 2464-9724

# Maritime Safety and Security Law Journal

2018
*Issue 4*

Maritime Safety and Security Law Journal

# The Effect of Unmanned Vessels on Canadian Law: Some Basic Legal Concepts

*Marel KATSIVELA**

**Abstract**

*For the first time the possibility exists for ships to navigate the world with no person on board. Unmanned vessels promise safer and less costly navigation at sea. However, arguments have been made that electronically operated devices may malfunction or be defective and that the cost-savings they operate may be offset by the cost of acquiring new sensors and operating systems. Automation in shipping will inevitably bring change in the rules governing shipping. At present, the International Maritime Organisation has added automation in shipping on its agenda for deliberation. The present study examines key Canadian legal concepts and provisions - likely to be present in the laws of other maritime states - that will be affected by the presence of unmanned vessels. Domestic regulatory definitions of the terms 'vessel', 'master', 'pilotage', 'seaworthiness' ('crew', 'seafarer', 'manning'), are examined in an effort to explore whether or to what extent applicable domestic rules need to be revisited. The author suggests that precisions and/or modifications should be made to the meaning of the above-mentioned terms in order to address the new unmanned vessel reality.*

**Keywords**: unmanned, vessels, autonomous, ships, Canada, robotics, automation

**First published online**: 12 October 2018

## 1. Introduction

From its origins in the Code of Hammurabi in Mesopotamia and Rhodian law in Ancient Greece to the present day, maritime law has been a specialised area of law.[1] Technological innovation has led the way to bigger, safer, more advanced ships promising faster, more efficient and cost-effective transportation of goods and people.[2] Regulatory, legal and psychological impediments have been overcome on this premise.[3] In recent years states, including Canada, have embraced the same trend

* Corresponding author details: Marel Katsivela, Associate Professor, University of Ottawa (Canada), *Programme de Common Law en Français*.

1 Doyle Slifer, 'The Classical Legacy of Admiralty: The Pre-Roman World (Part One of a Two-Part Series)' [2017] Illinois Business Law Journal <https://publish.illinois.edu/illinoisblj/2007/02/15/the-classical-legacy-of-admiralty-the-pre-roman-world-part-one-of-a-two-part-series/> accessed 24 July 2018. For the Rhodian law in ancient Greece, see Aliki Kiantou-Pampouki, *Nautiko Dikaio*, vol 1 (Sakkoulas 2003) 9.

2 ibid (Slifer).

3 Thanasis Karlis, 'Maritime law issues related to the operation of unmanned autonomous cargo ships' (2018) 17 WMU Journal of Maritime Affairs 119, 127.

of innovation leading the way to faster and more cost-effective ways of maritime transportation with regulatory reforms consequent upon technological changes.[4]

The trend continues today. For the first time the possibility exists for ships to navigate the globe with no one at the helm.[5] Unmanned ships are being configured to operate via remote control, autonomous means, or a combination of the two methods.[6] Technology has reached a point where self-navigating seagoing vessels is entirely feasible.[7] The British firm Rolls-Royce has demonstrated the world's first remotely operated commercial (tug) vessel[8] while the first unmanned vessel used for subsea positioning, surveying and environmental monitoring has already been registered in the United Kingdom (UK).[9] In 2018, the United States Navy acquired an unmanned vessel.[10] There are ongoing projects worldwide for the construction of (commercial) autonomous vessels.[11] Unmanned ships have a variety of potential uses:  they may be used for the transport of goods and passengers

4 For example, Canadian and international laws had to adapt to the introduction of containers in shipping cargo in the 1950s: W David Angus, 'Legal Implications of "The Container Revolution" in the International Carriage of Goods' (1968) 14(3) McGill Law Journal 395, 395-96; Trevor D Heaver, 'Shipping Industry', (*Canadian Encyclopedia,* 4 March 2015) <www.thecanadianencyclopedia.ca/en/article/shipping-industry/> accessed 24 July 2018. It has been noted that regulation should follow technology rather than lead it: Henry H Perritt Jr, 'Who Pays when Drones Crash?' (2017) 21 UCLA Journal of Law & Technology 1, 66; in general, see also Aldo Chircop, 'Testing International Legal Regimes: The Advent of Automated Commercial Vessels' (2018) (in press with the German yearbook of International Law) 3 <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3130453> accessed 24 July 2018. In the present study, the terms 'maritime' and 'shipping' will be used interchangeably. The same applies to the terms 'ship' and 'vessel'.

5 Paul W Pritchett, 'Ghost Ships: Why the Law Should Embrace Unmanned Vessel Technology' (2015) 40 Tulane Maritime Law Journal 197, 199. As per Chircop, ibid 5, there is good reason why unmanned and autonomous ships will not be technologies of passing interest. Today, there is a declining interest towards seafaring careers and a consequent shortage of seafarers.

6 ibid (Pritchett). See Lloyd's Register, 'LR defines "autonomy levels" for ship design and operation' (8 July 2016) <www.lr.org/en/latest-news/lr-defines-autonomy-levels-for-ship-design-and-operation/> accessed 24 July 2018, for a definition of different levels of automation.

7 Perritt (n 4) 12.

8 Rolls Royce, 'Rolls-Royce demonstrates world's first remotely operated commercial vessel' (2017) <www.rolls-royce.com/media/our-stories/press-releases/2017/20-06-2017-rr-demonstrates-worlds-first-remotely-operated-commercial-vessel.aspx> accessed 24 July 2018.

9 'First Unmanned Vessel Joins UK Ship Register' (*World Maritime News,* 14 November 2017) <https://worldmaritimenews.com/archives/235207/first-unmanned-vessel-joins-uk-ship-register/> accessed 24 July 2018.

10 Amanda Macias, 'The first drone warship just joined the Navy and now nearly every element of it is classified' (CNBC, 25 April 2018) <www.cnbc.com/2018/04/25/first-drone-warship-joins-us-navy-nearly-every-element-classified.html> accessed 24 July 2018.

11 The Norwegian project YARA Birkeland is envisioned to become the world's first electrically powered unmanned container ship. Canadian Shipper, 'How autonomous cargo boats could disrupt the massive shipping industry' (Canadian Shipper, 6 October 2017) <www.canadianshipper.com/transportation-and-logistics/autonomous-cargo-boats-disrupt-massive-shipping-industry/1003374961/> accessed 24 July 2018. Japanese shipping firms Mitsui OSK Lines and Nippon Yusen are working with shipbuilders including Japan Marine United to develop self-piloting cargo ships; 'Japan to launch self-navigating cargo ships "by 2025"' (BBC, 9 June 2017) <www.bbc.com/news/technology-40219682> accessed 24 July 2018. See also 'World's 1st Autonomous Shipping Company in the Making' (World Maritime News, 3 April 2018) <https://worldmaritimenews.com/archives/248731/worlds-1st-autonomous-shipping-company-in-the-making/> accessed 24 July 2018. The European Union is spending millions of dollars on funding regarding unmanned navigation. Isaac Arnsdorf, 'Rolls-Royce Drone Ships Challenge $375 Billion Industry: Freight' (Bloomberg, 25 February 2014) <www.bloomberg.com/news/articles/2014-02-25/rolls-royce-drone-ships-challenge-375-billion-industry-freight> accessed 24 July 2018.

(merchant shipping), hydrography, scientific marine research, the maintenance and repair of oil platforms, pipelines, ships and ports, laying submarine cables, surveillance, espionage, border surveillance, detection of smuggling and of narcotics.[12]

There are several advantages resulting from the introduction of robotics into shipping. Safety in maritime transport has always been of critical importance. Human error accounts for 75% or more of all marine casualties;[13] by eliminating human presence on board, autonomous vessels may also remove, or at least substantially reduce, human error. Further, the elimination of manned vessels may result in considerable cost savings in wages and accommodations for the crew leading, at the same time, to vessels that weigh less, have more space for transport and consume less fuel.[14] Unmanned vessel operation presents certain risks: human error may persist; electronically operated devices may malfunction or be defective; cost saving resulting from automation may be offset by costs of new sensors and operating systems.[15] Nonetheless significant improvement in overall safety can be achieved under the proposed systems.[16]

Regulation needs to address the legal issues presented by technological advances.[17] In a regulatory context, autonomy levels of unmanned ships may be summarized as follows:[18] *M: Manual navigation with automated processes and decision support* where the master and crew are on board and if, at times, the bridge is unmanned, an officer is on standby and ready to take control; *R: Remote-con-*

12 These are some of the uses noted. For these and more see Eric Van Hooydonk, 'The law of unmanned merchant shipping – an exploration' (2014) 20 Journal of International Maritime Law 403, 404.

13 According to Anita M Rothblum cited by Paul W. Pritchett, Pritchett (n 5) 201-02, 'fatigue, inadequate communication … and inadequate technical knowledge are the three largest factors contributing to human error'. See 'The Relation between Human Error and Marine Industry' (*Marine Insight News Network*, 21 July 2016) <www.marineinsight.com/marine-safety/the-relation-between-human-error-and-marine-industry/> accessed 24 July 2018, Maritime Unmanned Navigation through Intelligence in Networks (MUNIN) 'Research in maritime autonomous systems project results and technology potentials' (*MUNIN*, 2016) <www.unmanned-ship.org/munin/wp-content/uploads/2016/02/MUNIN-final-brochure.pdf> accessed 27 July 2018.

14 Pritchett (n 5) 201; MUNIN, ibid; Luci Carey, 'All Hands Off Deck? The Legal Barriers to Autonomous Ships' (2017) NUS Centre for Maritime Law Working Paper 17/06, 3 <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3025882> accessed 1 September 2018. Cost effectiveness may not be the same for all types of vessels. Apart from cost, automation and digitalization will create shore-based jobs in shipping which will appeal equally to men and women. 'In Depth: Shore-Based Jobs Big Opportunity for Women to Join Maritime' (*World Maritime News*, 12 March 2018) <https://worldmaritimenews.com/archives/246969/interview-shore-based-jobs-big-opportunity-for-women-to-join-maritime/> accessed 24 July 2018. However, labor unions doubt unmanned ships could be safe and cost-effective any time soon. Arnsdorf (n 11).

15 Also, in the absence of persons on board, the shore-based operator will be unable to react with the same intuitive feel for the situation (or at the very least a good deal less) and will depend on the satisfactory operation of all the onboard sensors and the transmission systems which gives rise to new kinds of dangers if such are i.e. defective. Van Hooydonk (n 12) 406. For a general discussion see Pritchett (n 5) 202.

16 Pritchett (n 5) 202 and MUNIN (n 13).

17 According to Perritt, at this stage, the barriers to actual commercial deployment lie also in the regulatory regimes rather than in the engineering one (Perritt (n 4) 12).

18 Danish Maritime Authority Report (DMAR), 'Analysis of Regulatory Barriers to the Use of Autonomous Ships' (December 2017) 6 <www.dma.dk/Vaekst/autonomeskibe/Pages/Foranalyse-af-autonome-skibe.aspx> accessed 1 September 2018, for what follows in the paragraph. See also Lloyd's Register (n 6).

*trolled vessel with crew on board* where the vessel is controlled remotely but a trained person is on board on standby and ready to take control in which case the level of autonomy shifts to *M; RU: Remote-controlled vessel without crew on board* where the vessel is controlled remotely without a crew on board. In this case, onboard electronic sensors feed information to a human operator not located on the vessel who then evaluates the relayed information and sends commands back to the vessel which will be carried out by the vessel's electronic systems;[19] *A: Autonomous vessel* where the vessel's operating system assesses risks present and reacts accordingly. If the system fails or requires human intervention the crew will intervene in which case the level of autonomy will shift to *R: Remote-controlled vessel with crew on board* or *RU: Remote-controlled vessel without crew on board* depending on whether or not there is a crew on board.[20]

Based on the above-mentioned classification, it is evident that the term 'unmanned ships' does not always refer to ships without a crew on board. Only the classifications *RU: Remote-controlled vessels without crew on board* and *A: Autonomous vessels* refer to vessels without crew on board. With regards to those vessels and existing regulation many questions may arise: is an unmanned vessel a vessel following the above-mentioned levels of automation? Do the regulatory references made to the master and crew or to the obligation that the vessel be manned have a *raison d'être* when there is no personnel on board? How is seaworthiness defined? To date, questions of this nature remain unanswered at the Canadian and international levels. The legal implications of automation in shipping as well as the extent of the initiatives undertaken in this area around the world have led the International Maritime Organization (IMO) to add unmanned vessels to its agenda for deliberation.[21] The regulatory approach to autonomous shipping should be considered carefully to prevent regulation negatively impacting technological developments and the commercial use of autonomous technol-

19 Pritchett (n 5) 199.

20 According to Karlis (n 3) 121, 'the concept of the autonomous system is based on four interdependent systems. The first regards a system of an array of sensors that provide situation awareness data of external (waves, swell, objects at sea etc.) and internal (machinery, systems, and cargo conditions) conditions. The second system regards the algorithms and software that interpret the sensors data and makes and/or suggests appropriate actions. The third system regards the manned shore control centre which confirms or realigns the decisions suggested by the automated system. The shore control centre assumes full control during port access or in the case of a systems failure. Finally, the fourth system is the ship herself and its specialised design that includes new construction materials and redundancy mechanical systems that kick in when the primary systems fail'. As Perritt ((n 4) 12) notes, whatever the mode of transportation (land, air or sea) robotic systems and automation strategies in general require 'good sensors and smart autopilots. All modes depend on radio control and are thus vulnerable to phenomena that impede radio waves. All depend on an appropriate human/machine interface. … Understanding what can go wrong requires understanding the underlying technologies.'

21 According to IMO deliberations, the organisation should take a proactive and leading role given the rapid technological developments relating to the introduction of commercially operated ships in autonomous/unmanned mode. The scoping exercise could include identifying: IMO regulations which, as currently drafted, preclude autonomous/unmanned operations; IMO regulations that would have no application to autonomous/unmanned operations (as they relate purely to a human presence on board); and IMO regulations which do not preclude unmanned operations but may need to be amended in order to ensure that the construction and operation of MASS ['maritime autonomous surface ships'] are carried out safely, securely, and in an environmentally sound manner. IMO Maritime Safety Committee (98th session) Scoping exercise on autonomous vessels put on agenda (16 June 2017) <www.imo.org/en/MediaCentre/MeetingSummaries/MSC/Pages/MSC-98th-session.aspx> accessed 24 July 2018.

ogies in shipping.[22] While awaiting international regulation, several national bodies have elaborated proposals regarding unmanned ships.[23]

Canada is among the states that will be affected by the introduction of automation in merchant shipping. Canada's coastline borders three oceans: the Atlantic, the Pacific and the Arctic.[24] It is a shipping nation and a major exporter of iron, coal and grain.[25] It is ranked among the first thirty ship-owning countries in the world[26] and has major ports along its east and west coasts.[27] As an IMO member state,[28] Canada will follow the IMO lead regarding regulation of unmanned ships.

The present study examines several key Canadian legal provisions regarding merchant shipping that will be affected by the presence of unmanned ships. Regulatory definitions of 'master', 'crew', 'seafarer', 'seaworthiness' (focusing on manning requirements), 'pilot' will be examined in an effort to explore whether or not, or to what extent, the applicable domestic rules need to be revisited and possibly amended in order to adapt to the reality of unmanned vessels. The levels of automation focused on are *RU: Remote-controlled vessel without crew on board* and *A: Autonomous Vessels* since these presuppose the absence of a crew on board – if a vessel is partially manned the effect on the regula-

22 DMAR (n 18) para 3.2.1. According to the report, considering the complexity of current shipping regulation the focus of the IMO should be on incorporating autonomous ships into the existing regulatory frame. New regulation of autonomous ships should only cover areas unique to autonomous ships that existing regulation does not take account of. Others opine that specific legal instruments should govern unmanned vessels instead of undertaking the extraordinary task of revising existing law. Pritchett (n 5) 223. Chircop (n 4) 30, suggests that amendment of a rule might be preferable to waiting for an interpretation from an authoritative body. In the present study, we will refer to revising or revisiting present rules without excluding the possibility of a separate instrument specifically applicable to unmanned vessels.

23 See, for example, Maritime UK, 'Being a Responsible Industry-A Voluntary Code' (*Digital Ship*, 20 November 2017) <https://thedigitalship.com/news/item/5231-autonomous-vessel-code-of-practice-launched> accessed 24 July 2018 (UK Code) and DMAR (n 18).

24 Canadian Wildlife Federation, 'The Challenge' (*Canadian Wildlife Federation*, 2018) <http://cwf-fcf.org/en/explore-our-work/coasts-oceans/?src=menu> accessed 24 July 2018. In the present study, arctic navigation will not be subject to detailed commentary.

25 United Nations Conference on Trade and Development, 'Review of Maritime Transport' (UNCTAD/RMT/2017) 11.

26 ibid 28. For the importance of the maritime sector in Canada historically see: Aldo Chircop, A William Moreira, Hugh M Kindred and Edgar Gold, *Canadian Maritime Law* (2nd ed, Irwin Law Inc 2016) 15-18 (CML).

27 'List of Canada Port Authorities' (*Transport Canada*, 23 January 2018) <www.tc.gc.ca/en/services/marine/ports-harbours/list-canada-port-authorities.html> accessed 24 July 2018. When considering that 38.3% of Canada's international trade moves by ship, the maritime sector is still extremely important to the Canadian economy. CML, ibid 18.

28 International Maritime Organisation (IMO), 'Member States' (*IMO*, 2018) <www.imo.org/en/About/Membership/Pages/MemberStates.aspx> accessed 24 July 2018. At the international level, Canada is very much involved – along with other countries – in conducting research (regulatory scoping exercise) on the regulatory framework that will govern unmanned vessels. The regulatory scoping exercise is taking place in coordination with the Maritime Safety Committee (MSC) of the IMO. Although work in this area is advancing, the IMO has not yet provided guidance on how best to address autonomous vessels.

tory framework in place will, most likely, not be substantial.[29] The analysis will not be exhaustive. It does however provide insight into the important impact technological advances will have on existing domestic rules and, while waiting for IMO guidance in this area, makes suggestions on the national direction regulation may follow. The study focuses at the national level on Canadian law, however the analysis may also be relevant to legislation of other maritime states.

## 2. Selected Canadian Regulatory Concepts and Unmanned Ships: An Exploration

Canada is a federation maintaining a division of powers between the federal and the provincial governments.[30] The federal government has jurisdiction over shipping and navigation.[31] Since unmanned vessels relate to navigation and shipping they should, in principle, fall within the federal jurisdiction.[32] 'Canadian maritime law' has been defined as 'all that body of law which was administered in England by the High Court on its Admiralty side in 1934 as such law may, from time to time, have been amended by the federal Parliament, and as it has developed through judicial precedent to date'.[33] Following this definition, federal legislation, regulations and English case law principles as received in Canada apply in this area. For this reason, federal enactments and case law principles relevant to our topic will constitute the main focus of analysis. What follows is an analysis of the Canadian law perspective on four key maritime law concepts (vessel, master, seaworthiness, pilotage) that are at the centre of any discussion concerning unmanned ships.

### 2.1 Vessel

Article 2 of the Canada Shipping Act (CSA) defines vessel as: 'a boat, ship or craft designed, used or capable of being used solely or partly for navigation in, on, through or immediately above water, without regard to method or lack of propulsion, and includes such a vessel that is under construc-

29 DMAR (n 18) for the levels of vessel automation. In the present study, we will use the term 'unmanned vessel(s)' to designate the vessels with automation levels *RU: Remote-controlled vessel without crew on board* and *A: Autonomous Vessels* (i.e. regarding the suggestions made) but also to designate, in general, automation in shipping. The suggestions made take account of the fact that they have to be broadly worded to accommodate partially manned or manned vessels as well. For the rest, insurance coverage, which may play an important role in adopting or amending existing rules in this area, will not make part of the present analysis.

30 Gérald A Beaudoin, 'Distribution of Powers' (*The Canadian Encyclopedia*, 23 October 2015) <www.thecanadianencyclopedia.ca/en/article/distribution-of-powers/> accessed 24 July 2018.

31 *Constitution Acts 1867 to 1982*, s 91(10). Attribution of navigation and shipping to the federal government was intended to preclude provincial jurisdiction over maritime matters with a view to maintaining uniformity of the applicable rules at the domestic level. The need for uniformity in maritime law is omnipresent in Canadian case law. *Ordon Estate v Grail*, [1998] 3 SCR 437 para 84, *ITO-Int'l Terminal Operators v Miida Electronics*, [1986] 1 SCR 752, 788 (*ITO*). Provincial and federal courts have concurrent jurisdiction over maritime matters. *Federal Courts Act* (FCA) RSC 1985 c F-7 art 22(1).

32 This presupposes that the case in question is intrinsically connected to maritime matters. *ITO* (ibid 774).

33 *ITO-Intl* (n 31) 771.

tion'.[34] This broad definition focuses on the use of the vessel for navigation on water without regard to its propulsion or the fact that it is under construction.[35] Other acts refer to this definition or contain a similar – and often shorter - definition of the term.[36]

The proposed UK Code and Danish Maritime Authority Report (DMAR) definitions of an autonomous ship emphasize the absence, in whole or in part, of human control on board and the possibility to operate it remotely or autonomously,[37] an element that is absent from the CSA vessel definition. This is possible due to the presence of onboard sensors (i.e. cameras, radars),[38] algorithms and software that interpret data and propose appropriate actions and the shore control centre that, depending on the level of automation, may play a more or less important role in the navigation of the ship.[39] The proposed definitions add to the existing CSA definition of a vessel because they presuppose, on the one hand, the presence of a ship and, therefore, its capability of navigating on water without regard to the method or lack of propulsion adding, on the other hand, the fact that it is autonomous or remotely controlled without human presence on board. In this way, nothing in the CSA definition of the term vessel excludes its application to unmanned ships.[40] Rather, said proposals build on what is already present in the CSA definition. Considering, however, that the CSA when put into context reflects the current reality of a ship being controlled by persons present on board, it would be better to adopt a definition of an unmanned vessel that would not violate the CSA (and would include, therefore, the vessel's capability to navigate on water without regard to the method or lack of propulsion), adding the autonomous or remote controlling of the vessel without human presence on board.[41]

---

34 CSA 2001 (SC 2001 c 26). The definition adds: 'It does not include a floating object of a prescribed class (*bâtiment*)'.

35 For details on propulsion see CML (n 26) 46s. On the broad definition of the term vessel see: *Cyber Sea Technologies, Inc. v Underwater Harvester Remotely Operated Vehicle*, 2002 FCT 794 (a remotely-controlled submersible constitutes a ship), *Salt Spring Island Local Trust Committee v B & B Ganges Marina Ltd.*, 2008 BCCA 544 (stressing the fact that a vessel should be used in navigation and that every ship is a vessel, but not every vessel is a ship.), *TJ Inspection Services v Halifax Shipyards*, 2004 NSSC 181, paras 38-39 (a topside structure does not constitute a vessel).

36 Referring to the CSA (n 34) – definition: Coasting Trade Act, SC 1992 c 31, art 2(1), Canada Transportation Act, SC 1996 c 10 s 147. For similar definitions see Canada Marine Act, SC 1998 c 10, art 2(1), Marine Liability Act, SC 2001 c 6 (MLA), arts 25(1) and 36(1). At the international and the domestic levels there is no comprehensive definition of the term vessel. The term is defined based on the purpose of each convention or act. Van Hooydonk (n 12) 406-09 citing different authors and conventions.

37 According to the UK Code, UK code (n 23) art 2: 'MASS' – Maritime Autonomous Surface Ship means, for the purpose of this code, a surface ship that is capable of being operated without a human onboard in charge of that ship and for which the level of control may encompass any of those shown at Table 2.3 above. The diagram referred to in the code is similar to the classification here presented (n 18) and accompanying text. DMAR (n 18) 67 proposes the following definition of 'autonomous ships': 'ships capable of providing – via automatic processes or systems – decision support or making it possible to take over parts of or the entire human control and steering of the ship, irrespective of whether the exercise of control/steering is done from the ship or from somewhere else.'

38 Rolls Royce, 'Remote and Autonomous ships The Next steps' Advanced Autonomous Waterborne Applications Initiative White paper 2016' 1-31 <www.rolls-royce.com/~/media/Files/R/Rolls-Royce/documents/customers/marine/ship-intel/aawa-whitepaper-210616.pdf> accessed 24 July 2018 (Whitepaper).

39 See (n 19) and accompanying text and (n 20) on the new technologies used.

40 For a similar conclusion based on international conventions and national laws examined see Canadian Maritime Law Association, 'CMI Questionnaire on Unmanned Cargo Ships' (2018) 1.1 <http://comitemaritime.org/wp-content/uploads/2018/05/CMI-IWG-Questionnaire-Unmanned-Ships-CANADA.pdf> accessed 24 July 2018 (CMLA) reasoning on a cargo ship, Van Hooydonk (n 12) 409, White paper (n 38) 37. Chircop (n 4) 9-10.

41 For specific wording that could be used to reflect this reality see the proposed definitions in (n 37). Case law could provide further precision of the proposed regulatory definition.

## 2.2 Master

Article 2 CSA[42] defines 'master' as 'the person in command and charge of a vessel. It does not include a licensed pilot, within the meaning of Section 1.1 of the Pilotage Act, while the pilot is performing pilotage duties under that Act. (*capitaine*)'. If this definition is examined in isolation, there is nothing that requires the physical onboard presence of the master.[43] What is required is a person in command and charge of a vessel. When the CSA and other national and international rules/conventions are read as a whole, however, they reflect the traditional view of a vessel operating with a master on board.[44] For example, provision for the master to use force or detain a person on board in order to maintain the security on the vessel (Article 83 CSA) is irrelevant if the master is not physically present.[45]

Proposed regulation on unmanned ships does not require the physical presence of the master on board but presupposes that such a person be able to discharge the tasks of a controlling officer remotely.[46] For vessels with a level of automation *RU: Remote-controlled vessel without crew on board*, it is likely that the remote operator will act as the master.[47] Obligations to issue bills of lading for

42 CSA (n 34). For a similar definition see Migratory Birds Convention Act a*rt 2.1 under 'master'. Under the* Marine Transportation Security Act, SC 1994 c 40, art 2.1.a (iv) an operator is defined – among other things – as 'a master or other person who has command or charge of the vessel, other than a pilot'.

43 As Van Hooydonk (n 12) 413 notes based on international conventions and domestic acts, such broad definitions of the term master are not directed at the new situation of unmanned shipping but could in principle be applied to it. Case law on the definition of a master is scarce. *B.C. Ferry Services Inc. v BC Ferry and Marine Workers' Union*, 2010 CanLII 86715 (BC LA) stated that 'by law and tradition, the Master of the Vessel is in charge of the vessel and has the responsibility for the safe operation and management of the vessel'. Although the case concerned a labor issue, it notes that the master's authority – as the person being in charge and command of the vessel - is found in the CSA (n 34).

44 The CSA (n 34), often refers to the master or crew on board. See, for example, art 16.4(e)(i), 82(1), 87, 94(1), 97(4). The Marine Personnel Regulations, SOR/2007-115 (MPR) accompanying the CSA contain similar provisions: art106 (2) (a) requires presence of the master on board for certification purposes. The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, Annex, ch. 1, reg. 1/1(3) (opened for signature 7 July 1978, entered into force 28 April 1984) 1361 UNTS 2 (STCW) often refers to seafarers/persons serving 'on board'. Also, Canadian case law often uses the term master in a way that human presence on board is required. *Spinney v The Ocean Mutual Marine Ins. Co* (1890) 17 SCR 326 cites the following: 'The said loss occurred and was caused by the barratry of the master and mariners on board of the said vessel'; *R. v Motor Vessel Glenshiel*, 2001 BCCA 417 para 1 referring to an 'act or omission of the master or some other person on board'. For a similar discussion under UK and international law see Carey (n 14) 16.

45 The mention 'on board' in various parts of the CSA (n 34) and MPR (ibid) may not always be adapted to the unmanned vessel reality.

46 Following the UK code (n 23) art 2: '"Master" […] mean[s] a specific person officially designated by the owning company/owner of the vessel as discharging the responsibilities of the Master of the vessel. This will be an employee of the company who has been assessed as competent to discharge these responsibilities in accordance with the provisions of this code. This person may be located anywhere provided that the required level of control and communication can be maintained to discharge these duties'. DMAR (n 18) 67 defines the remote operator as 'a person with the necessary qualifications who performs or monitors the navigation of one or more autonomous ships without being physically present on board the ship and who is entitled to represent the ship vis-à-vis the authorities'. The report notes that the remote operator should be considered equal to the master.

47 DMAR (n 18). See also Pritchett (n 5) 209 and Robert Veal and M Tsimplis, 'The integration of unmanned ships into the lex maritima' [2017] Lloyd's Maritime and Commercial Law Quarterly 303, 317.

the carriage of good by sea or to rescue distressed vessels and people at sea – a fundamental tenet of maritime law- may be discharged by the remote operator.[48] For fully autonomous vessels (level *A: Autonomous vessels*) a computer has command of the vessel and there does not appear to be any person who can directly hold the status of master as defined.[49] But a compelling argument can be made that the person who programmed the control system, the owner or charterer of the vessel or the vessel itself is 'in charge' and is thus the master who must fulfil his/her obligations such as the duty to rescue.[50] Further, the absence of the master in the event of unmanned merchant shipping does not mean that no valid transport document such as bills of lading can be issued but, rather, that these documents will be issued in electronic form.[51]

Probably not wanting to distance itself greatly from existing national and international standards (a justified approach while waiting for IMO direction), the UK Code designates as the controlling commander of any unmanned vessel (including those with levels of automation *RU: Remote-controlled vessel without crew on board* and *A: Autonomous vessel*) the master, a person specifically designated

48 Pritchett (n 5) 208-09 for the obligation to rescue vessels and people at sea. The master's duty to rescue is sanctioned by the United Nations Convention on the Law of the Sea (UNCLOS) (adopted 10 December 1982, entered into force 16 November 1994) 1833 UNTS 397, art 98(1), the International Convention for the Safety of Life at Sea (SOLAS) (adopted 1 November 1974, entered into force 25 May 1980) 1184 UNTS 278, chapter V, regulation 33 and Canadian law (CSA arts 130-32) following a similar wording. According to DMAR (n 18) 3.5.2, the fact that a ship is unmanned should not exempt the master from his/her obligation to provide rescue. See also CMLA (n 40) 3.3 for a similar conclusion under Canadian law. The master's obligation to issue bills of lading is sanctioned by the Hague Visby Rules (art 3.3) applicable in Canada to the carriage of goods by sea. The Visby Rules refer to the Hague Rules [The International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading (adopted 25 August 1924, entered into force 2 June 1931) 120 LNTS 155 (1924)] as amended by two protocols: the Protocol to Amend the International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading, (adopted 23 February 1968, entered into force 23 June 1977) (commonly known as the 'Visby Protocol 1968') and the Protocol Amending the International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading (adopted 21 December 1979, entered into force 14 February 1984). Although the remote operator may issue bills of lading in the case of remote-controlled vessels without crew on board, some functions relating to this obligation i.e. checking the quality and the quantity of goods being loaded and unloaded in different ports will probably need to be delegated to others (for example local port agents). For the delegation of functions see DMAR (n 18) 3.5.6.

49 Pritchett (n 5) 209 for the duty to rescue.

50 Pritchett (n 5) 209. The author adds that if a fully autonomous vessel fails to fulfill a legal obligation to rescue, it could be said to be defective and thus expose the manufacturer of the vessel to liability. DMAR - (n 18) 3.5.2 - notes that the challenge for remote controlled vessels without a crew and fully autonomous vessels is to be able to physically rescue persons, ships and goods. However, UNCLOS and SOLAS (n 48) do not seem to require that the obligation to rescue should exceed the technical capability of the vessel (design, equipment and arrangement). See also CMLA (n 48) and Carey (n 14) 18-20. Further, some authors suggest that technology and equipment can be developed to address rescue operations at sea by unmanned vessels. Erich D Grome, 'Spectres of the Sea: The United States Navy's Autonomous Ghost Fleet, its Capabilities and Impacts and the Legal Ethical Issues that Surround' (2018) 49 Journal of Maritime Law & Commerce 31, 52. DMAR (n 18) suggests that the IMO should clarify the content of the international conventions' provisions regarding rescue with respect to unmanned ships.

51 Van Hooydonk (n 12) 419. For the general trend towards digitalisation of transport documents see below (n 86). See also Anastasia Papadolpoulou, 'Autonomous technology: opportunities and challenges faced in shipping and transportation' (*Keystone Law,* 24 November 2017) <https://keystonelaw.co.uk/keynotes/autonomous-technology-opportunities-and-challenges-faced-in-shipping-and-transportation> accessed 28 July 2018.

by and an employee of the shipping company who may discharge his duties remotely.[52] If we follow this proposal that maintains the master as the person in charge and command of the unmanned vessel – such a suggestion is closer to the present reality – the CSA definition of the term 'master' does not warrant revisiting since it does not restrict the person in charge of the vessel to being physically present on board. Considering, however, that regulatory provisions currently applicable at the domestic and the international levels refer to the on board presence of the master or may translate in practice as requiring such presence, it would be preferable to revise the term, making it clear that the person in command and charge of the vessel may operate it remotely provided that the required tasks can be discharged remotely.[53] The specific qualifications, tasks and existing regulatory provisions referring to the on board presence of the master will also have to be revisited in order to adapt to the use of new technology and level of automation of the vessel.[54]

## 2.3 Pilotage

The CSA definition of the term 'master' excludes pilots;[55] pilots are subject to the Pilotage Act.[56] When a ship enters a mandatory pilotage area, local pilots with knowledge of the area are engaged to navigate the vessel.[57] According to Article 1.1. of the Pilotage Act, a pilot is 'any person who does not belong to a ship and who has the conduct of it'. Although the definition does not refer to the physical presence of a pilot, pilots do board vessels in order to navigate them.[58] Waivers to compulsory pilotage may be given to a vessel for different reasons– for example: the ship is engaged in rescue operations; the ship is in distress or seeking refuge; pilots are unavailable – provided for by regulation of the respective pilotage authorities.[59]

---

52 See (n 46) for the proposed definition of a master. UK Code (n 23) art 1.1.6 states that the intent is to ensure a degree of equivalence with the provisions of the current IMO instruments. Art 1.1.14 rightfully adds that when relevant requirements are developed at the national, regional or international levels, revision of the code may be considered immediately.

53 See (n 44) (existing rules) and (n 46) (proposed definition of the term) and accompanying text. For a general commentary and the need for reform see CMLA (n 40) 1.4 concluding that under Canadian law a master cannot be a chief on shore remote controller, chief pre-programmer or another person responsible on paper but not immediately involved with the operation of the ship.

54 For some of these provisions see (n 44). If the master is the controlling commander, a question that will need to be answered by legislators is whether a damage caused by a defective automated system on a fully autonomous vessel may render the master - or crew -, the manufacturer or the programmer of the system liable. For similar questions see Comité Maritime International (CMI), 'CMI International Working Group Position Paper on Unmanned Ships and the International Regulatory Framework' (2018) 18 <http://comitemaritime.org/wp-content/uploads/2018/05/CMI-Position-Paper-on-Unmanned-Ships.pdf> accessed 24 July 2018. Case law could provide further precision regarding the regulatory definition of the term master, its qualifications, tasks and liability.

55 See (n 42) on the definition of the master and accompanying text.

56 RSC 1985, c P-14.

57 There are four pilotage authorities in Canada: Atlantic (Halifax); Laurentian (Montreal); Great Lakes (Cornwall); Pacific (Vancouver). According to the Pilotage Act art 18, pilotage authorities establish, operate, maintain and administer an efficient pilotage service within their respective regions. They have the power to designate compulsory pilotage areas within their geographic reach. See *Alaska Trainship Corporation et al. v. Pacific Pilotage Authority*, [1981] 1 SCR 261 for a decision on the scope of the Pacific Pilotage Authority's powers under the Pilotage Act.

58 Among others, Pilotage Act arts 20.1.l, 27.1(a), 33.1(c) also refer to the 'on board' presence of the pilot.

59 See, for example, the Pacific Pilotage Regulations, CRC c 1270 art 10.1, the Atlantic Pilotage Authority Regulations, CRC c 1264 art 5.1, 5.2, the Great lakes Pilotage Regulations CRC c. 1266 art 5. According to these regulations, in the case of unavailability of pilots the master or all persons in charge of the deck must be familiar with the route and the marine traffic control system in the compulsory pilotage area. For similar exemptions see the Laurentian Pilotage Authority Regulations CRC c. 1268 art 5. For respective Canadian pilotage authorities see (n 57).

Article 25(2) of the Pilotage Act provides that a licensed pilot who has the conduct of a ship is responsible to the master for its safe navigation. The pilot as well as the owner or master of a ship may be held liable for any damage or loss occasioned by it to any person or property on the ground due to the fault, neglect, want of skill or wilful and wrongful act of a licensed pilot (Article 41 Pilotage Act).[60] However, if a pilot is held liable for fault, neglect or want of skill, his/her liability is only limited to 1,000 CAD (Article 40(1) Pilotage Act).

For remotely-controlled or autonomous vessels, it is not certain whether it is technically possible to be subject to shore-based pilotage with a pilot navigating the ship remotely rather than from the bridge.[61] In the absence of regulation allowing shore-based pilotage – if such is technically possible – or, alternatively, an exemption to pilotage, the access to certain ports or to mandatory pilotage areas may be restricted for these types of vessels.[62] This will inevitably impede commerce. It is therefore crucial to provide for rules allowing shore-based pilotage or provide for an exemption to pilotage for unmanned vessels at the national and international level.[63] In case of the former, the definition of the term 'pilot' should include the possibility of remote operation without physical presence on board – similar to the definition of the term 'master'. This will clarify an element that is not excluded by the present statutory definition.

If shore-based pilotage is possible the licensing qualifications, tasks and provisions of the Pilotage Act referring to the onboard presence of pilots (for example, Articles 25, 26, 27 Pilotage Act)[64] will also need to be reviewed. For the rest, legislators will have to determine whether the existing liability regime applicable to pilots and provided for by the said act – for example, the fact that the pilot may be liable to the master (Article 25(2)), pilots' liability limits (Article 40(1)) as mentioned above – will remain the same.

---

60 *Westshore Terminals Ltd v Leo Ocean SA* (2014) SA, 2014 FC 132 where due to the pilot's error in navigation there was a collision with the property of a third person. The pilot was held liable despite an expired certificate of competency and his liability was limited.

61 DMAR (n 18) 54, 21s. As the report suggests, for fully autonomous ships subject to mandatory pilotage, the operation must be presumed to change to a remotely controlled one with an operator taking over navigation. According to the Transport Canada Pilotage Act Review Discussion, currently, neither Canada's pilotage legislative or regulatory framework prescribes the use of any particular technology, such as shore-based pilotage systems to help navigate vessels. Canada needs to establish minimum standards for new technologies to ensure that adopting them does not compromise safety. Transport Canada, 'Pilotage Act Review Discussion' (*Transport Canada*, 2017) <www.tc.gc.ca/en/reviews/pilotage-act-review-discussion.html> accessed 26 July 2018.

62 ibid, DMAR (n 18). For a general discussion of these points see also Carey (n 14) 21-30.

63 DMAR (n 18). Case law could provide further precision of the adopted rules. For the role of Canada on unmanned vessels in general see (n 28).

64 See also Pilotage Act (n 58).

## 2.4 Seaworthiness

One fundamental obligations of the ship-owner in maritime law is to provide a seaworthy vessel.[65] This requires that the vessel be capable of withstanding the ordinary perils of the sea, be fit for the proposed trip and be crewed by competent crew.[66] Exercise of due diligence is generally required to carry out this obligation.[67] One of the attributes of a seaworthy ship is that it should be properly manned. Manning will constitute the specific focus of this part of the analysis. Under Article 82(2) CSA: 'No master of a Canadian vessel shall operate it unless it is staffed with a crew that is sufficient and competent for the safe operation of the vessel on its intended voyage and is kept so staffed during the voyage'.[68] This requirement has traditionally referred to the obligation of having a competent crew (i.e. experienced, trained, properly instructed) to operate it.[69]

In the case of unmanned vessels, it is critical that the obligation to provide a seaworthy vessel be

65 CSA (n 34) art 85. The master is responsible for the vessel's seaworthiness usually acting as a representative for the ship-owner. Seaworthiness runs like a thread through maritime law. William Tetley, *International Maritime and Admiralty Law* (International Shipping Publications 2002) 52-53. On this obligation see also the Hague, Hague Visby Rules (n 48) art III(1). Arctic navigation – which is not the focus of the present study – requires specific conditions for the construction, structure and design of a vessel following the adoption of the Polar Code (International Code for Ships Operating in Polar Waters). As a result, for a vessel to be seaworthy for arctic navigation additional conditions may apply. For more on the Polar Code, see IMO, 'Shipping in Polar Waters' <www.imo.org/en/MediaCentre/HotTopics/polar/Pages/default.aspx> accessed 24 July 2018. Navigating on ice may mitigate against use of unmanned cargo ships in arctic waters during seasons when ice may be present. CMLA (n 40), Additional Canadian Comments: 1.

66 *Vukorep v Bartulin* 2005 BCCA 142 (Vukorep) – citing case law regarding a seaworthy ship which must be fit for the intended voyage, in good repair, properly equipped and safe for those on board'. *Direct Transport Co. v Detroit & Windsor Ferry Co.* 1935 CanLII 317 (ON SC) 432 - seaworthiness applies not only to the condition of the vessel itself, but also to the condition of the cargo and there is a duty upon the owner of the vessel to insure that the cargo – particularly deck cargo – is properly secured before the vessel sets sail. *Doman Forest Products Ltd. v Arctic Hooper (Ship)* 2003 FCT 712 paras 157, 166, 178 - Seaworthiness has also been interpreted as including the provision of a competent master and crew, proper loading instructions given; it is not limited to the vessel's structural soundness. In the present case, the vessel was seaworthy. *Falconbridge Nickel Mines Ltd. v Chimo Shipping Ltd* 1969 CarswellNat 362 (Exch CC) para 61 – the vessel was unseaworthy due to an inadequately secured tractor that rendered the barge unstable - (*Falconbridge*). See also William Tetley, *Marine Cargo Claims*, vol 1 (4th ed, Yvon Blais 2008) 877-88 and CML (n 26) 507.

67 *Dominion Glass Co. Ltd. v The Ship Anglo Indian and Her Owners* [1944] SCR 409; *Primex Forest Products Ltd. v Harken Towing Co. Ltd.* 1997 CanLII 4161 (BC SC). See also Tetley, ibid 876, stating that due diligence is diligence of a reasonably prudent carrier as at the time of the relevant acts or omissions and not in hindsight. On the contrary, the common law duty of seaworthiness is absolute: it is no excuse that the owner did not know of a defect or that he exercised due diligence to make the vessel seaworthy.

68 This is an obligation that is sanctioned by international conventions adopted by Canada: UNCLOS (n 48) art 94(4)(b), Maritime Labor Convention (adopted 23 February 2006, entered into force 20 August 2013) 45 ILM 792 regulation 2.7 (MLC), the International Safety Management Code for the Safe Operation of Ships and for Pollution Prevention (adopted 17 November 1993, entered into force 1 July 1998) IMO Resolution A.741(18) art 6.2, SOLAS (n 48) regulations 14, 15, the Hague Visby Rules (n 48) arts III.1.b and IV.1. Usually, decisions on manning are decided at the domestic level. White Paper (n 38) 43.

69 *Robin Hood Flour Mills, Ltd. v N.M. Paterson & Sons Ltd* 1966 CarswellNat 407 para 24, 26 (*Robin*) - the ship was unseaworthy because it was not properly manned; citing English case law - see (n 66) on more cases regarding the requirement of having a competent crew. CML (n 26) 617, 507s.

maintained. This is one of the core concepts of maritime law.[70] One of the questions that arise with regard to these ships concerns responsibility for providing a seaworthy vessel. Proposals have been made that responsibility for vessel's seaworthiness should rest with the ship-owner since this person can ensure compliance with the obligation due to the technological insight possessed and the ability to make the necessary arrangements to fulfill this obligation.[71] Such a solution coheres with the present domestic and international reality and may be adopted.[72]

In this regard, the ship's manning – one of the attributes of the vessel's seaworthiness – requires ensuring crew competence.[73] Following Canadian regulatory provisions, the term 'crew' has been defined as 'a person other than a trainee or the Master engaged in the business of the ship'.[74] A 'seafarer' is defined as 'a person who is employed or is to be employed in any capacity *on board* a vessel'.[75] More general regulatory provisions seem to require the presence of crew-seafarers on board.[76] Taking these provisions into account an unmanned vessel cannot be manned if there is no crew on board.[77]

---

70 As Carey (n 14) 3-4, rightfully notes, unseaworthiness exposes ship-owners to cargo claims since, in its presence, they may not benefit from the exclusions in the Hague and the Hague Visby Rules. Unseaworthiness can also void a marine insurance policy. The vessel's seaworthiness has a long history: under the Rhodian law [Kiantou-Pampouki (n 1) and accompanying text] there was no general obligation of the ship-owner to provide a ship in a good state and condition; however, a seaworthiness provision was to be found in situations where great and valuable cargo was loaded on ships. More specifically, merchants were recommended to ensure that the ship-owner provides a ship in a good state, with its proper tackle and a sufficient number of skillful mariners. The provision was not binding but operated as a mere recommendation affording no legal consequences to the parties involved. As reported by Nikolaos Karpantais, 'Seaworthiness in autonomous unmanned cargo ships' (LLM thesis, University of Rotterdam 2016) 7 <www.researchgate.net/publication/311452364> accessed 24 July 2018.

71 DMAR (n 18) 26, 68.

72 See (n 65) and accompanying text - the ship-owner is responsible for the vessel's seaworthiness. As it is currently the case, case law could further clarify questions on attribution of liability.

73 See (n 66) and (n 69) and accompanying text on the requirement of having a competent crew.

74 Transport Canada, 'Standard Relating to Design, Construction and Operational Safety of Sail Training Vessels- TP 13313 E' (2017) <www.tc.gc.ca/eng/marinesafety/tp-tp13313-menu-143.htm> (under 'definitions') accessed 24 July 2018.

75 MPR (n 44) art 1. Also, MLC (n 68) art 2.1.f contains a similar definition of a seafarer. Even though there is no reported Canadian case law on the definitions of 'crew' and 'seafarer', cases routinely refer to them as persons on board a vessel: *Rederiet A.P. Moller A/s v Seafarers' International Union of Canada* 1997 CanLII 4733 (FCA), *Boudreault v Great Circle Marine Service Inc.* 2004 CHRT 21.

76 MPR (n 44) arts 106.2.a among others, CSA (n 44) also refers to the 'master or crew on board'. The STCW (n 44) talks about a 'personnel on board', 'those on board', 'seafarers (on board)' which reflects the traditional view of having crew on board the vessel. For this and other national and international laws containing similar provisions see also Van Hooydonk (n 12) 413.

77 For this general discussion under UK law see Carey (n 14) 9. In this regard, authors have asked the question whether an ordinary, careful and prudent ship-owner should send a ship at sea under the command of a crew trained only on simulators. Karlis (n 3) 124. A similar question asks whether a prudent ship-owner shouldn't provide for a human presence on board an unmanned vessel in the case of goods declared hazardous before the sea voyage and that need to be handled/disposed in transit. DMAR (n 18) 89. It is hard to see at this stage how technology could handle such an incident and how a vessel could be considered seaworthy in this case in the absence of human presence on board.

It has been suggested that if the vessel is capable of operating safely without being manned this obligation may be fulfilled.[78] The suggestion stresses the end result of the obligation to provide a properly manned vessel – safety in navigation - rather than the presence of a crew on board. Another suggestion, evidently complementing the previous one, maintains the term 'crew' and defines it as 'a person employed or engaged in any capacity on-board a ship on the business of the ship or any person engaged in the direct control and operation of the ship from a remote location'.[79] This definition implies that a crew may still be involved in the control and the operation of an unmanned vessel but its physical presence on board is not required (shore-based crew).

The proposed definition of the term 'crew' may seem compatible with its corresponding one under Canadian law which does not exclude shore-based personnel.[80] However, the domestic and international definition of a 'seafarer' and the general Canadian regulatory context requiring the presence of crew on board do not conform to the unmanned vessel reality.[81] In adhering to the proposed definition, existing domestic and international rules requiring the presence of crew or seafarers on board need to be revisited to allow the operation of the vessel to be discharged remotely.[82] From a regulatory perspective, this also means that existing regulations relating to the presence of qualified crew members (crew members' articles of agreement regarding their position, documents of employment, wages, record of service, discharge, serious violation of contract or the death of a crew member[83])

78 White Paper (n 38) 43-44, DMAR (n 18) 23 (for ships remotely controlled), Veal and Tsimplis (n 47) 320, Carey (n 14) 4 citing case law.

79 UK Code (n 23) art 2 under 'crew'.

80 Transport Canada (n 74) and accompanying text.

81 See (n 75-76) and accompanying text on the requirement of having the crew on board. CMLA notes that amending or rethinking these international standards as we enter an era of increasingly unmanned ships is possible.

82 Combining the definition of a 'seafarer' under Canadian regulations [(n 75) and accompanying text on this definition] and the proposed definition of a 'crew' under the UK code [(n 79) and accompanying text on the definition of the term 'crew'] a seafarer could be defined as: 'a person who is employed or is to be employed in any capacity on board a vessel on the business of the vessel or any person engaged in the direct control and operation of the vessel from a remote location'. We could reason similarly for the term crew. Case law interpretation could provide further precision of the definition chosen. The suggested definition of the term crew or seafarer does not abolish the vessel's crew. In this way, it does not distance itself greatly from the present reality. This may counter the skepticism of unions regarding unmanned vessels. For the unions' scepticism see Arnsdorf (n 11). More general questions arise whether substitution of artificial intelligence for human judgement is socially acceptable. Chircop (n 4) 34. See also (n 77) for other questions in this area.

83 CSA (n 34) arts 91(1) (articles of agreement), 92 (Discharge), 93(1) (Record of sea service), 95 (Desertion or serious violation of contract), 97 (death of a crew member), *Marine Insurance Act* (SC 1993 c 22) s 11 (insurable interest - wages). *Makar v Rivtow Lion (Vessel)* 1981 FC 2773 (article of agreement), *Mark Fishing Co. v United Fishermen & Allied Workers' Union* 1972 CanLII 1016 (BC CA) (discharge). Also, with regard to the crew, certain acts' and international conventions' provisions that exclude crew members or the master from their scope could be maintained under the suggested definition. For example, CSA s 2 excludes from the term 'passenger' the master and the crew. For corresponding provisions see also the MLA (n 36) Part 3 art 28 (3) and Part 4 art 37(2). It is interesting to note that under the current law the master and crew members have a maritime lien for unpaid wages. This lien is highly ranked compared to liens of other maritime creditors. MLA (n 36) art 138(1)(b), CSA art 86(1). Case law: *Comeau's Sea Foods Ltd v The Frank and Troy* (1971) CF 556, *Osborne Refrigeration Sales & Service Inc v The Atlantean I* (1979) 2 FC 661, 1982 CanLII 2936 (FCA). Since in the presence of unmanned vessels crew, and therefore crew wages, may eclipse or reduce in number, so will the maritime lien benefiting them. This will constitute a bonus for mortgage creditors since the pool of claimants ranked before them (i.e. maritime liens) will shrink.

may be maintained and / or revised in order to accommodate the unmanned vessel reality.[84] It is only certain regulatory provisions that have as *a raison d'être* the physical presence of the personnel on board (i.e. onboard accommodation, shore leave)[85] that may be less relevant to remotely controlled or fully autonomous vessels.

The extent to which technology will be used, the level of the vessel's automation and regulatory choices made will play a role in determining what constitutes a seaworthy vessel.[86] In all cases, in order to provide for seaworthiness it will be important to monitor and understand how technology operates and the risks it may present for an unmanned ship.[87] This will allow regulation and ensuing case law to enhance safe navigation and justice in the choices made.

## 3. Conclusion

The analysis has highlighted that regulatory action will be required to address legal issues raised by unmanned vessels. Such action will require revisiting existing Canadian applicable rules.[88] Suggestions have not greatly departed from the present domestic – and international – regulatory framework since this is the current regulatory basis upon which shipping operates effectively.

To summarise the suggestions; first, even though the CSA definitions 'vessel' and 'master' and the Pilotage Act definition 'pilot' are sufficiently broad to accommodate the unmanned vessel, their remote operation/discharging of duties without human presence on board should be expressly provid-

84 Concerning the crew's training it is evident that corresponding – to the STCW (n 44) – training requirements will have to be developed for persons operating a ship remotely. White paper (n 38) 47, 48, Chircop (n 4) 25. Karlis (n 3) 123-24, Carey (n 14) 8 on the need for regulation in general.

85 Marine Transportation Security Regulations, SOR/2004-144 art 206(1)(c), 325.1.g (shore leave), 240(2)(h): (crew accommodations).

86 For example, a seaworthy vessel must have updated documentation (i.e. certificates) and charts on board. On an unmanned vessel, these will need to be available/produced digitally. Some countries (Denmark, Singapore, Norway) have already adopted regulations regarding the digital production of at least some of these documents. Denmark has already adapted its regulation to issue digital ship certificates and has, furthermore, concluded a Memorandum of Understanding (MoU) with the Singaporean and Norwegian maritime authorities on the spread of digital certificates internationally. DMAR (n 18). Canada does not currently issue digital certificates but considers such a possibility. The IMO (FAL.5/Circ.39/Rev.2) has invited governments to take the necessary actions at the national level to ensure that adequate legislation is in place for the use and acceptance of electronic certificates as may be required, providing guidelines to this effect.

87 Where there is less human control the reliability and problem-solving capacity of an autonomous system become crucial. Regulation does not provide clear-cut answers to questions regarding liability of autonomous operations whether, for example, the manufacturer, the ship-owner or other person should be liable in the case of defective equipment or programming rendering the vessel unseaworthy. For similar concerns see (n 54). Answers to such problems should be provided for. Legal conclusions applicable to road traffic may not be transferable to shipping. White paper (n 38) 50.

88 Although not the object of the present study, this also implies that international rules upon which domestic laws are based will also need to be revisited. For a recent discussion of the regulatory impact of unmanned vessels on international conventions see Chircop (n 4), CMI (n 54), Veal and Tsimplis (n 47).

ed for.[89] The qualifications and tasks of the master and pilot and the provisions referring to their 'on board' presence in existing rules should also be revisited.

Second, the obligation to provide a seaworthy vessel will certainly be a prerequisite for unmanned vessels as it is the case today. This obligation will most probably be entrusted to the ship-owner. To the extent to which technology will be used in rendering a vessel seaworthy, the level of technology of the vessel and regulatory choices made will play a role in determining the content of this obligation.

Third, regarding seaworthiness, minimum manning requirements may remain for unmanned ships, but they may not refer to maintaining a competent crew on board but, rather, to having qualified shore-based personnel to operate them. In this regard, although the term crew as defined by Canadian law is sufficiently broadly worded to accommodate the new reality contrary to the term seafarer, both terms need to be worded so that there is no requirement for physical presence on board. In all cases, existing rules concerning the (on board) presence, employment terms, tasks and qualifications of crew/seafarers should be revisited to determine whether they reflect the reality of a shore-based personnel.

The introduction of unmanned vessels at sea is certain. It promises safer and less costly operations. This new era of automation will inevitably bring change in the rules governing shipping. The object of the present article has been to examine specific key Canadian legal concepts and provisions – likely to be present in the laws of other maritime states - that will be affected by this new reality and to make suggestions for the direction that future regulation may take. The wind of change is blowing in shipping. Since we cannot control the wind (of technological change) we will have to adjust the sails.[90]

89 For pilotage, if shore-based pilotage is not possible, an exemption to mandatory pilotage for unmanned vessels would be necessary so that the new reality does not constitute a hurdle to trade.

90 Paraphrasing the lyrics of the song Ricky Skaggs, 'Can't control the wind' (Atlantic 1995).