
The law of unmanned merchant shipping – an exploration

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Maritime law appears to be relatively well armed for the introduction of unmanned (either remotely operated or autonomous) merchant ships. This policy-oriented article explores whether existing public and private maritime law (and law of the sea) can in principle still be applied, examines what existing rules will require amendment or expansion and considers what new rules might have to be developed.

I. Will the *lex maritima* survive the disappearance of the seafarer?

Hardly a day goes by without one astounding technological innovation or another being announced. It seems quite probable that crewless, remote-controlled ships and even completely autonomous ones, thanks to advances in artificial intelligence, will sooner or later take to the oceans of our world. What, however, will the effect of such phantom ships be on the law? What new regulatory measures will become necessary, and will maritime law have to undergo a thorough overhaul?

On the face of it there would appear to be no reason for concern. Maritime law has after all a reputation for being one of the most stable areas of the law. Many of its concepts and rules go back hundreds of years. The status of the master and the pilot, the charterparty, the bill of lading, liability in collisions, salvage, general average, limitation of liability, marine insurance, the arrest of ships, etc are largely derived from national and local laws and scholarly writings from the pre-Napoleonic era, if not from compilations made in the Middle Ages, and some of its principles were even first enunciated in the Ancient World. In the last two centuries maritime law has been like a rock in the seething currents of technical and political change. Rules which were established in the days of sail have been successfully adapted to the introduction of steam, diesel and nuclear propulsion, the ever-growing size of ships and ports, two World Wars, the development needs of new states, the introduction of unitized cargo capable of being seamlessly transferred to other modes of transport and public indignation about oil spills and ferry disasters. Of course maritime law is being continually adjusted and refined, among other things by international harmonization, the improvement of compensation mechanisms, and increasingly detailed technical standardization requirements, but the core, the international *lex maritima*, with its underlying concepts and practices appears to be unaffected.¹

In this contribution we explore the relevance of existing maritime law to the regulation of the status of unmanned ships. To this end, we must first of all adjust our terminology. Internationally, when speaking of unmanned means of transport, mention is made mostly of Unmanned Vehicles (UVs).

¹ See in this connection E Van Hooydonk 'Towards a worldwide restatement of the general principles of maritime law' (2014) 20 *JIML* 3 170–82.

These include (1) Unmanned Aerial Vehicles (UAVs), (2) Unmanned Ground Vehicles (UGVs) and (3) Unmanned Marine Vehicles (UMVs). The latter category may be divided up in different ways, for example into (1) Unmanned (Water) Surface Vehicles (USVs) and (2) Unmanned Underwater Vehicles (UUVs). Another approach is to make a distinction between (1) Remotely Operated Vehicles (ROVs) and (2) Autonomous Vehicles (AVs). These first are operated by humans at a remote location, in particular from a shore-based control centre that has a wireless connection to the ship and where radar, camera and/or satellite images and other data supplied by the ROV is collected and interpreted (such tele-operated craft may also be described as drone ships, and make one think of the radio-controlled model ships we knew in our childhood). Other, even more sophisticated 'smart' vessels are self-guided and depend on preprogrammed instructions or artificial intelligence. They process the data collected by their on-board sensors themselves, form an independent opinion, take decisions about navigation and optimize their response to traffic on a continuous basis. Apart from fully autonomous craft, there are also semi-autonomous craft, which perform routine manoeuvres within the context of the instructions given to them, but which are supervised by humans and can if necessary be corrected or overridden. With craft used for underwater inspection and exploration it has been observed that the degree of autonomy can differ greatly² and for the time being at least the options for merchant ships remain open. In studies the human operator is often referred to as the 'shore-based controller', although in this article we prefer to use the term 'shore-based vessel controller'. The terminological (and inevitably the legal) line between an unmanned vessel on the one hand and waterborne robots, capsules, torpedoes and buoys on the other is not always clearly drawn. Craft such as underwater robots may sometimes be better considered as part of a ship or part of its equipment, because such things belong by necessity to a (mother) ship.

Unmanned vessels can be used for an endless variety of purposes. Like many technical innovations the first initiatives were of a military nature. Nowadays various countries use unmanned surface and submarine craft for surveillance, transport, espionage, mine clearance and as assault devices. Border surveillance, the detection of smuggling and of the import of narcotics are likewise obvious potential uses, but unmanned underwater craft have long been used for civil purposes as well, for example for undersea mapping, hydrography, scientific marine research, mineral prospecting, the maintenance and repair of oil platforms, pipelines, ships and ports, laying submarine cables and the location and examination of wrecks. What so far has not achieved a breakthrough is the unmanned commercial carriage of goods and passengers.

In recent years the unmanned vessel has been the subject of extensive technological and legal research. This article has been prepared in the context of the European I2C research project, which has had as its object the development of an integrated and partly automated monitoring system for shipping-related threats and to which this author contributed as legal researcher. In 2013 this project led to the demonstration of an unmanned inspection and detection craft in the Mediterranean. Another European project is investigating the technical feasibility of the operation of crewless bulk carriers³ and has already had a brief look at some of the specific legal aspects, namely the applicability of the COLREGs and the STCW Convention.⁴ Writing as long ago as 2000 Britain's

² See X *The Operation of Autonomous Underwater Vehicles. Volume One: Recommended Code of Practice for the Operation of Autonomous Marine Vehicles* (2nd edn London 2009) 47–48, in which the following degrees of autonomy are distinguished: None, Basic, Intermediate, Advanced and Highly Advanced.

³ Here the reference is to the 'Maritime Unmanned Navigation through Intelligence in Networks' project (the MUNIN project) see www.unmanned-ship.org for the literature, including an overview paper by H C Burmeister, Ø J Rødseth *Beyond the e-Navigation implementation plan: Development towards the unmanned merchant vessel?* (2014).

⁴ International Regulations for Preventing Collisions at Sea 1972 as annexed to the Convention on the International Regulations for Preventing Collisions at Sea (Collision Regulations) (London 20 October 1972 as amended); International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW Convention) (London 7 July 1978 as amended). See F Safari, B Sage *Legal and Liability Analysis for Remote Controlled Vessels* MUNIN 4 September 2013, www.unmanned-ship.org. In our opinion the authors are rather too quick in assuming that the existing obligations of the Master and Chief Engineer are analogous to or must be complied with by operators working in a ship control centre. In our view the relevant rules will have to be examined in greater detail and adjusted where necessary. Further legal analysis will at the very least have to make a clear distinction between the situation *de lege lata* and recommendations *de lege ferenda*.

Society for Underwater Technology asked Professors Edward Brown and Nick Gaskell to examine the legal status of the autonomous underwater vehicles used for marine scientific research.⁵ Likewise the implications in international law of unmanned military vessels have also been studied in detail.⁶ Positions were being adopted about the legal aspect of the protection of marine mammals from the noise and harassment caused by autonomous underwater craft as long as ten years ago.⁷ Furthermore there is an ever-growing list of articles and papers about the status of unmanned aircraft, which consider aspects such as airworthiness, the rules of flight and privacy. However, an all-in exploration of the legal status of commercial, surface-operating unmanned cargo and passenger vessels – in other words unmanned merchant ships – is as far as we know still lacking and it is on this that the article will be concentrating.⁸ Whether existing maritime law can in principle still be applied, what existing rules will require amendment or expansion, and what new rules might have to be developed will be examined. This study is therefore exploratory and is aimed at policy makers. Emphasis will be on the maritime law aspects, but it is impossible not to include an exploration of some of the basic principles of the law of the sea.⁹

Although the historical evidence shows that practicable new technologies inevitably break through into economic and social life, the technical and economic feasibility and the political desirability of crewless maritime transport will not be covered here. Anybody who reflects on how immensely difficult it can be for a ship's master and his pilot to bring a modern sophisticated ship safely to its berth, will probably think that a transition to fully crewless navigation is hopelessly unrealistic, or simply reject the idea outright as irresponsible, if not morally objectionable. Indeed at present it is unclear what business model would be suitable for operating unmanned merchant ships, how the necessary service required for operating them would be organized, and how this might be shared among the various parties, and what kinds of contracts might be required (although this latter is briefly considered below¹⁰).

Risks will nonetheless have to be covered. At first sight unmanned transport would eliminate the human factor, which according to widely accepted estimates, accounts for roughly 80 per cent of all

⁵ These studies were published in three volumes, the Code of Practice was updated in 2000. See X (n 2); E D Brown, N J J Gaskell *The Operation of Autonomous Underwater Vehicles. Vol Two: Report on the Law* (London 2000); *Vol Three: The Law Governing AUV Operations* (London 2001).

⁶ See inter alia C H Allen 'The seabots are coming here: should they be treated as "vessels"?' [2012] *The Journal of Navigation* 749–52; G Cho 'Unmanned aerial vehicles: emerging policy and regulatory issues' [2012–2013] *Journal of Law, Information and Science* 201–36; J Davis 'The (common) laws of man over vehicles unmanned. Comment' [2011] *Journal of Law, Information and Science* 166–79; M T DeGarmo *Issues Concerning Integration of Unmanned Aerial Vehicles in Civil Airspace* (McLea, Virginia 2004); B Gogarty, M Hagger 'The laws of man over vehicles unmanned: the legal response to robotic revolution on sea, land and air' [2008] *Journal of Law, Information and Science* 73–45; B Gogarty, I Robinson 'Unmanned vehicles: a (rebooted) history, background and current state of the art' [2011] *Journal of Law, Information and Science* 1–34; G Hallevey 'Unmanned Vehicles: Subordination to Criminal Law under the Modern Concept of Criminal Liability. Comment' [2011] *Journal of Law, Information and Science* 200–11; A H Henderson 'Murky waters: the legal status of unmanned undersea vehicles' [2006] *Naval Law Review* 55–72; I Henderson 'International law concerning the status and marking of remotely piloted aircraft' [2010–11] *Denver Journal of International Law and Policy* 615–28; S A Kaiser 'Legal aspects of unmanned aerial vehicles' [2006] *Zeitschrift für Luft- und Weltraumrecht* 344–363; S A Kaiser 'Third party liability of unmanned aerial vehicles' [2008] *Zeitschrift für Luft- und Weltraumrecht* 229–37; B Kapnik 'Unmanned but accelerating: navigating the regulatory and privacy challenges of introducing unmanned aircraft into the national airspace system' [2012] *Journal of Air Law and Commerce* 439–65; D Marshall 'Unmanned aerial systems and international civil aviation organization Regulations' [2009] *North Dakota Law Review* 693–713; R McLaughlin 'Unmanned naval vehicles at sea: USVs, UUVs, and the adequacy of the law' [2011] *Journal of Law, Information and Science* 100–115; U Pagallo 'Guns, ships, and chauffeurs: the civilian use of UV technology and its impact on legal systems' [2011] *Journal of Law, Information and Science* 224–233; T M Ravich 'The integration of unmanned aerial vehicles into the national airspace' [2009] *North Dakota Law Review* 597–622; S Showalter 'The legal status of autonomous underwater vehicles' [2004] *The Marine Technology Society Journal* 80–83; V Tasikas 'Unmanned aerial vehicles and the doctrine of hot pursuit: a new era of coast guard maritime law enforcement operations' [2004–2005] *Tulane Maritime Law Journal* 59–80.

⁷ S Showalter *ibid.*

⁸ Other commercial functions, such as eg the exploration and exploitation of mineral resources are not explored here.

⁹ EU law, which merits separate examination, is not considered here.

¹⁰ Section 5.

marine casualties. Even so the reliability and safety of electronically operated devices is likewise not entirely copper-bottomed. Furthermore, to the extent that unmanned ships are operated or guided by human operators, the human factor will continue to play a role. Moreover because he or she is not on board, the shore-based vessel controller will be unable to react with the same intuitive feel for the situation (or at the very least a good deal less). Indeed because the operator will be dependent on the satisfactory operation of all the sensors on board and the transmission systems, new kinds of dangers will arise. Safe autonomous operation too will ultimately depend on the satisfactory operation of the on-board equipment, the required connections with shore stations and the stability of the computer programs.

Just as when other industrial processes were automated in the past, the introduction of crewless vessels will also have a social dimension. What will happen to the occupations that are no longer required? What new forms of employment, training and qualifications will become necessary? The uncertainties also include the psychological thresholds that the operators of unmanned passenger ships will have to overcome. Will passengers want to sail in a ship which is not in the oaken hands of a bearded and weather-beaten captain and without a crew that can ensure order and safety? Will public opinion, environmentalists and politicians accept the passage of unmanned oil and chemical tankers close to our coasts and allow them access to our ports?

On a lighter note let us consider the possibility of unmanned recreational navigation – would there be any pleasure in sailing around the Greek islands in a remotely controlled or fully automatic boat? Or would that make such a trip even less stressful? Will the heroic maritime adventure on which maritime law has flourished degenerate into dull digital amusement – or become a horror film full of crashing IT systems and demented artificial intelligence making off with floating bombs? What, however, is certain is that a huge portion of romance, tradition and culture will be sacrificed for the sake of the anticipated gain in efficiency. But let us now embark on our automated legal expedition.

2. Is the unmanned ship a ship?

To begin, is the unmanned ship, with no captain or crew on board, still a ship? If not, the question arises whether such an unmanned ship is governed (or should be governed) by maritime law. Or should maritime law apply to every artefact that is used on the seas?

As the late lamented Bill Tetley once observed, the legal definitions of ‘ship’ and ‘vessel’ differ greatly from one international maritime convention to another, because they are ‘very much a function of the subject matter concerned’.¹¹

In the law of the sea the term is not strictly defined.¹² Even the UN Convention on the Law of the Sea¹³ does not define it and uses the English terms ship and vessel interchangeably.¹⁴ There is even less of an established description of the term in international customary law. Most commentators undoubtedly rightly assume that for the purposes of the law of the sea unmanned vessels must be regarded as ships.¹⁵ The rules of the LOSC, which define the rights and duties of states in connection with international shipping thus also apply to the operation of unmanned ships.

Numerous international public law maritime conventions dealing with specific topics apply their own definitions tailored to the matter at hand. In the London Dumping Convention¹⁶ the phrase

¹¹ W Tetley *International Maritime and Admiralty Law* (Cowansville Québec 2002) 35.

¹² Compare H Meyers *The Nationality of Ships* (The Hague 1967) 8–23.

¹³ United Nations Convention On The Law Of The Sea (LOSC Convention) (Montego Bay 10 December 1982).

¹⁴ See in particular S N Nandan, S Rosenne and N R Grandy *United Nations Convention on the Law of the Sea 1982. A Commentary* (Dordrecht/Boston/London 2003) vol II 45–46 no 1.28; S N Nandan, S Rosenne and N R Grandy *United Nations Convention on the Law of the Sea 1982. A Commentary* (The Hague/London/Boston 2002) vol III 101 no 90.8(b).

¹⁵ See J Kraska ‘The law of unmanned naval systems in war and peace’ [2010] *The Journal of Ocean Technology* 44, 51–53; compare A H Henderson ‘Murky Waters: The Legal Status of Unmanned Undersea Vehicles’ [2006] *Naval Law Review* 55, 64–67, 72.

¹⁶ Convention On The Prevention Of Marine Pollution By Dumping Of Wastes And Other Matter (London Mexico City, Moscow and Washington 29 December 1972 as amended).

‘[v]essels and aircraft’ means ‘waterborne or airborne craft of any type whatsoever’, to which is immediately added: ‘This expression includes air cushioned craft and floating craft, whether self-propelled or not’.¹⁷ ‘Ship’ in the United Nations Convention on Conditions for Registration of Ships¹⁸ means ‘any self-propelled sea-going vessel used in international seaborne trade for the transport of goods, passengers, or both, with the exception of vessels of less than 500 gross registered tons’.¹⁹ The Collision Regulations²⁰ consider a ‘vessel’ to be ‘every description of water craft, including non-displacement craft, WIG craft²¹ and seaplanes, used or capable of being used as a means of transportation on water’.²² The MARPOL Convention²³ defines a ‘[s]hip’ as ‘a vessel of any type whatsoever operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms’.²⁴ In the 2005 SUA Convention²⁵ the ship is ‘a vessel of any type whatsoever not permanently attached to the sea-bed, including dynamically supported craft,²⁶ submersibles, or any other floating craft’.²⁷ The Wreck Removal Convention²⁸ and the earlier Intervention Convention²⁹ use a very similar definition. Inevitably there will be unmanned ships that run aground or founder. To look a very long way ahead, sunken UMWs will after a while – in any case 100 years after the casualty – be considered for protection as underwater cultural heritage.³⁰

Numerous conventions dealing with private maritime law are applicable to seagoing vessels and do not provide any definition. This for example is the case with the 1910 Collision Convention,³¹ the 1910 Salvage Convention,³² the 1952 Ship Arrest Convention,³³ the 1999 Ship Arrest Convention,³⁴ the 1926 Convention on Maritime Liens and Mortgages,³⁵ the 1993 Convention on Maritime Liens and Mortgages³⁶ and the LLMC Convention.³⁷ As for inland navigation the drafters of the CMNI³⁸ provide no definition of a vessel whatsoever. Instruments that do contain a definition, reveal a wide variety of choices. The Hague Rules³⁹ define a ship as ‘any vessel used for the carriage of goods by

¹⁷ Article III.2. This definition was reproduced in the Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 (London 7 November 1996) art 1.6.

¹⁸ United Nations Convention on Conditions for Registration of Ships (Geneva 7 February 1986).

¹⁹ Article 2.

²⁰ COLREGS (n 4).

²¹ The 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 (r 3(m)).

²² Rule 3(a). In this connection the question has arisen of whether the requirement that it relates to ‘a means of transport by water’ would have as a consequence that unmanned vessels that do not carry cargo or persons, but only their sensors (such as a patrol or espionage craft) do not fall under the COLREGS. See inter alia in connection with the applicability of the COLREGS, McLaughlin (n 6) 100, 112.

²³ International Convention for the Prevention of Pollution from Ships (MARPOL) (London 2 November 1973 as amended).

²⁴ Article 2.4.

²⁵ Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (SUA Convention) (Rome 10 March 1988 as amended).

²⁶ The concept of ‘dynamically supported craft’ refers to hydrofoil boats and air-cushion vehicles (see the Code for Dynamically Supported Craft adopted by IMO Resolution A.373(X) of 14 November 1977).

²⁷ Article 1.1(a).

²⁸ Nairobi International Convention on the Removal of Wrecks (Nairobi 18 May 2007) art 1.2.

²⁹ International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969 (Brussels 29 November 1969 as amended) art II.2.

³⁰ See LOSC art 303 as well as the definitions in art 1 of Unesco Convention on the Protection of the Underwater Cultural Heritage (Paris 6 November 2001).

³¹ Convention for the Unification of Certain Rules of Law with respect to Collisions between Vessels (Brussels 23 September 1910).

³² Convention for the Unification of Certain Rules of Law respecting Assistance and Salvage at Sea (Brussels 23 September 1910).

³³ International Convention Relating to the Arrest of Sea-Going Ships (Brussels 10 May 1952).

³⁴ International Convention on the Arrest of Ships (Geneva 12 March 1999).

³⁵ International Convention for the Unification of Certain Rules relating to Maritime Liens and Mortgages (Brussels 10 April 1926).

³⁶ International Convention on Maritime Liens and Mortgages (Geneva 6 May 1993).

³⁷ Convention on Limitation of Liability for Maritime Claims 1976 (London 19 November 1976).

³⁸ Convention on the Contract for the Carriage of Goods by Inland Waterways (Budapest 22 June 2001).

³⁹ International Convention for the Unification of Certain Rules of Law relating to Bills of Lading (Brussels 25 August 1924).

sea'.⁴⁰ No significant divergence from this definition is to be found in the Rotterdam Rules.^{41,42} CLC 1992⁴³ describes a 'ship' equally broadly as 'any sea-going vessel and seaborne craft of any type whatsoever constructed or adapted for the carriage of oil in bulk as cargo [. . .]'.⁴⁴ The HNS Convention⁴⁵ and the Bunker Convention⁴⁶ adopt a similar approach. The 1989 Salvage Convention⁴⁷ defines a 'vessel' broadly as 'any ship or craft, or any structure capable of navigation'.⁴⁸ Other conventions go into more detail. CLNI 2012⁴⁹ defines 'vessel' as 'an inland navigation vessel used for commercial navigational purposes and shall also include hydrofoils, ferries and small craft used for commercial navigational purposes but not air-cushion vehicles' and adds 'Dredgers, floating cranes, elevators and all other floating and mobile appliances or plant of a similar nature shall also be considered vessels'.⁵⁰

National maritime laws give an equally heterogeneous picture.⁵¹ In the United States, for example, the word 'vessel' includes 'every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water'.⁵² The UK's 1995 Merchant Shipping Act provides that the 'ship' includes 'every description of vessel used in navigation'.⁵³ The Dutch Civil Code understands 'ships' to be all things 'that are not an aircraft, which pursuant to their construction are intended for flotation and which float or have floated'.⁵⁴ The Maritime Code of the People's Republic of China defines 'ship' as 'sea-going ships and other mobile units, but does not include ships or craft to be used for military or public service purposes, nor small ships of less than 20 tons gross tonnage'.⁵⁵ Spain's 2014 Navigation Act defines the 'buque' as 'every vehicle with a structure and capacity for navigation on the sea and intended for carrying persons or things with a continuous deck and a length equal to or greater than twenty-four metres'.⁵⁶ In the draft version of the proposed new Belgian Merchant Shipping Code, which is founded on thorough comparative law research, the ship is 'every craft, with or without its own propulsive power, with or without displacement, that floats or has floated and that is used or which is suitable for use as means of traffic on the water, including air-cushion craft but to the exclusion of fixed devices, waterplanes and amphibious vehicles'.⁵⁷ The prospect of unmanned merchant shipping once again shows that it is wise to make statutory definitions that can be easily adapted so that the status of specific devices can be regulated.⁵⁸

⁴⁰ Article 1(d). The original French version speaks of 'tout bâtiment employé pour le transport de marchandises par mer'.

⁴¹ United Nations Convention on Contracts for the International Carriage of Goods Wholly or Partly by Sea (Rotterdam 23 September 2009).

⁴² Ship means 'any vessel used to carry goods by sea' (art 1.25).

⁴³ International Convention on Civil Liability for Oil Pollution Damage (Brussels 29 November 1969 as amended).

⁴⁴ Article 1.1.

⁴⁵ International Convention on Liability and Compensation for Damage in connection with the Carriage of Hazardous and Noxious Substances by Sea 1996 (London 3 May 1996).

⁴⁶ International Convention on Civil Liability for Bunker Oil Pollution Damage 2001 (London 23 March 2001) art 1.1.

⁴⁷ International Convention On Salvage 1989 (London 28 April 1989).

⁴⁸ Article 1(b).

⁴⁹ Strasbourg Convention of 2012 on the Limitation of Liability in Inland Navigation (CLNI 2012) (Strasbourg 27 September 2012).

⁵⁰ Article 1.2(b). This definition is similar to that in the Convention on the registration of inland navigation vessels (Geneva 25 January 1965) which provides that 'the term "vessel" shall be deemed to include hydroplanes, ferryboats, dredges, cranes, elevators and all other floating appliances or plant of a similar nature' (Article 1.1(b)).

⁵¹ See S F Gahlen 'Ships revisited: a comparative study' (2014) 20 *JIML* 4 252–69.

⁵² 1 USC §3.

⁵³ Section 313(1).

⁵⁴ Article 8:1.1.

⁵⁵ Article 3 para 1.

⁵⁶ Article 56.

⁵⁷ E Van Hooydonk *Proeve van Belgisch Scheepvaartwetboek (Privaatrecht). Schepen. Derde blauwboek over de herziening van het Belgisch scheepvaartrecht* (Antwerp 2012) 35 *et seq* (art 3.1, 1°).

⁵⁸ For examples of provisions authorizing the Executive to adjust the area of application for special craft, see the UK Merchant Shipping Act, s 311, the Dutch Civil Code art 1.2, 2.2 and 3.3; the Belgian *Proeve* *ibid* art 3.3.

From the above brief exploration it may be concluded with a considerable degree of certainty that having a crew on board, including a master, is not generally regarded as an essential part of the notion of a ship in the regulatory definitions of the ship available to us.⁵⁹ Although some legal doctrine stresses the essential importance of the typically maritime on-board labour community (in addition to the technically essential characteristics of a ship),⁶⁰ unmanned ships would be covered by the great majority of the existing regulatory definitions and it would appear that the existing conventions and national laws would in principle continue to be functional in respect of these craft.

3. Is the unmanned ship still linked to a flag state?

Even though in the context of the UN Convention on the Law of the Sea there are no obstacles to considering unmanned craft as ships, with the effect that the rules of the freedom of navigation on the high seas, the EEZ and above the continental shelf as well as of the right of innocent passage through the territorial sea remain fully applicable,⁶¹ this does in our view not mean that no questions arise.

It is clear that the unmanned ship will have to fly the flag of a state. What is more difficult to determine is how the required genuine link⁶² between the flag state and the ship must be conceived, in particular how the flag state will effectively exercise 'its jurisdiction and control in administrative, technical and social matters' over the ship.⁶³ The LOSC requires that every state shall assume jurisdiction under its internal law over each ship flying its flag and over its master, officers and crew in respect of administrative, technical and social matters concerning the ship.⁶⁴ In addition, every state shall take the measures necessary to ensure safety at sea with regard to, inter alia, 'the manning of ships, labour conditions and the training of crews, taking into account the applicable international instruments'.⁶⁵ Such measures shall include those necessary to ensure

- (a) that each ship, before registration and thereafter at appropriate intervals, is surveyed by a qualified surveyor of ships, and has on board such charts, nautical publications and navigational equipment and instruments as are appropriate for the safe navigation of the ship;
- (b) that each ship is in the charge of a master and officers who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship;
- (c) that the master, officers and, to the extent appropriate, the crew are fully conversant with and required to observe the applicable international regulations concerning the safety of life at sea, the prevention of collisions, the prevention, reduction and control of marine pollution, and the maintenance of communications by radio.⁶⁶

These provisions of the UN Convention are quoted at length in order to make two things clear. First the provisions of the LOSC about the nationality of ships are designed for conventional ships controlled by a master, officers and a crew. Secondly the question arises whether the provisions addressed towards the flag state regarding the master, officers and crew in connection with unmanned ships are (1) either pointless and will therefore remain unapplied or (2) must be applied by analogy to the shore-based controller of the ship. In practical terms this question will boil down to whether a shore-based vessel controller who has an unmanned ship under his control can be

⁵⁹ This should not cause any surprise as dumb (towed or pushed) barges are in inland navigation regarded as vessels (see the analysis of concepts in J G ter Meer *Privaatrechtelijke aspecten van de sleep- en duwvaart* (Zwolle 1993) 18–23).

⁶⁰ See eg the ship as *work-sharing total process* ('arbeitsteiliger Gesamtprozeß') V Athanassopoulou *Schiffsunternehmen and Schiffsüberlassungsverträge* (Tübingen 2005) 7.

⁶¹ See Brown, Gaskell (n 5) 25, 79 (although doubting the designation of an AUV as a ship); A H Henderson 'Murky Waters: The Legal Status of Unmanned Undersea Vehicles' [2006] *Naval Law Review* 55, 68–72; J Kraska 'The law of unmanned naval systems in war and peace' [2010] *The Journal of Ocean Technology* 44 53–57.

⁶² LOSC art 91.1.

⁶³ LOSC art 94.1.

⁶⁴ LOSC art 94.2(b).

⁶⁵ LOSC art 94.3(b).

⁶⁶ LOSC art 94.4.

regarded as a 'master' in the meaning of the existing text of the LOSC.⁶⁷ A teleological approach and the application of the effectiveness principle might possibly justify this approach. However as the task of a shore-based vessel controller is not entirely similar to that of a ship's master⁶⁸ one cannot escape the feeling that such an interpretation is too extensive and slips into interpretation *per analogiam*, something that tends to be frowned upon in international law.⁶⁹

Returning to the problem of the genuine link it could be that this concept – the credibility of which continues to be doubtful in view of the ineradicable phenomenon of substandard shipping sailing under a number of less-than-strict flags of convenience – is entirely illusionary in respect of unmanned shipping. What does the link between the ship and flag state still represent when the owner of the unmanned ship is not necessarily established in that state, when the ship never calls in the ports of that state and when it is controlled and monitored by an anonymous operator sitting at a control desk somewhere in a distant low cost country, or by a computer program created in one or other country and operating 'in the cloud'? Instead of being genuine the link would then be virtual in the highest degree.

When the intrinsic volatility of international maritime business is married to the notorious slipperiness of information technology, artificial intelligence and worldwide data communications, finding such a link will become an exercise in formal futility. It can be questioned if it would not be pointless to try and force unmanned shipping into the legal straitjacket represented by the 'nationality' of a ship, which itself is an outgrowth of the nineteenth century notion of a geographically demarcated state guarded by strict frontier posts.⁷⁰ Furthermore what is to be done about the old (but now defunct) doctrine that a ship is part of the territory of the flag state?⁷¹ Would it be relevant or useful to revive such notions when a gigantic unmanned embarkation sails into a port near you?

The possibility of the commercial breakthrough of unmanned merchant shipping would provide a good opportunity to give the basic concepts of the Convention on the LOSC a thorough overhaul. Anybody who cares to browse through the convention will immediately see a whole series of other legal problems arising. How will flag states discharge their obligation to ensure that vessels flying their flag or of their registry carry on-board certificates?⁷² What will happen to the obligation of flag states to require masters to render assistance to any person found at sea in danger of being lost, and after a collision to render assistance to the other ship?⁷³ Could an unmanned ship whose controlling software has been hacked from the shore, another ship or an aeroplane be regarded as a pirate ship?⁷⁴ How must the right of visit⁷⁵ and the right of hot pursuit⁷⁶ be exercised when neither the crew, nor the ships' documents are to be found on board? Should the rules on the prompt release of crews be applicable to shore-based controllers?⁷⁷ An exhaustive critical screening of the LOSC would indeed be very welcome at that juncture.

⁶⁷ The use of the term 'master' is indicative that the relevant provisions of the convention refer to merchant ships (S N Nandan, S Rosenne and N R Grandy *United Nations Convention on the Law of the Sea 1982. A Commentary* (The Hague/London/Boston 2002) vol III 146, no 94.8(c)).

⁶⁸ See Section 4.

⁶⁹ On the interpretation of conventions in general see inter alia N Quoc Dinh, P Daillier, M Forteau and A Pellet *Droit international public* (8th edn Paris 2009) 275 *et seq*; M N Shaw *International Law* (5th edn Cambridge 2003) 838 *et seq*; and on interpretation *per analogiam* see eg R Bernhardt *Die Auslegung völkerrechtlicher Verträge* (Cologne/Berlin 1963) 181–82.

⁷⁰ In connection with the origin of the 'nationality' of the ship see H Meyers *The Nationality of Ships* (The Hague 1967) 27–30; for a recent reconsideration see eg Institut du droit économique de la mer *Le pavillon* (Paris 2008).

⁷¹ See inter alia Meyers *ibid* 14; Quoc Dinh (n 69) 1337 no 694; R Wolfrum 'Hohe See und Tiefseeboden (Gebiet)' in R Wolfrum (ed) *Handbuch des Seerechts* (Munich 2006) 287, 303–304, no 36.

⁷² LOSC art 217.3.

⁷³ LOSC art 98. See also Section 5.

⁷⁴ LOSC art 101, 102 and 103 (note the passage 'the persons in dominant control' in the latter provision).

⁷⁵ LOSC art 110 (esp art 110.2 on the checking of the documents of the suspected ship).

⁷⁶ LOSC art 111 (esp art 111.4 on the obligation to give 'a visual or auditory signal to stop [. . .] at a distance which enables it to be seen or heard by the foreign ship'; see Tasikas (n 6).

⁷⁷ LOSC art 292.

Moreover in our view room should be made for a debate about the absence of any provision in the UN Convention about the status of vessels in internal waters. Likewise the right of access to ports in international law is not considered there, but left to international custom and to (mostly) bilateral conventions. In connection with granting access to their ports will coastal states react in the same way as they did to the appearance of nuclear-powered ships in the 1960s? Will special traffic-routing measures be adopted, such as marking out reserved traffic lanes at sea? What measures will become urgently necessary to facilitate international maritime traffic, and what changes will have to be made to the FAL Convention?⁷⁸ The Annex to this Convention certainly supports the electronic exchange of information.⁷⁹

New strict, international and uniform technical safety standardization will be absolutely essential for the introduction of an unmanned merchant service, which will in all likelihood, be implemented in the context of the SOLAS Convention and the rules of classification societies. Very likely, Port State Control will play a prominent role in monitoring the application of international rules on unmanned shipping. Of the three classic primary objectives of safety regulations, namely to ensure safety at sea, prevent human injury or loss of life and avoid damage to the environment,⁸⁰ the second might appear set to become academic. However, as long as both manned and unmanned vessels ply the seas (which is likely to continue at least into the foreseeable future) such an appearance is illusory, and measures must be adopted to ensure that unmanned ships do not bring the seafarers on board other vessels into danger. Thorough technical standardization, certification, and inspection of unmanned vessels and in particular of the systems controlling them will without a doubt be of vital importance. The Collision Regulations, which admittedly already allow exceptions for vessels of special construction,⁸¹ will also have to be refined. The same applies to the rules governing Port State Control, which assume the possibility of on-board inspections and elementary standards of behaviour vis-à-vis the master.⁸² The International Safety Management Code will also have to be revised as is discussed below.⁸³

The registration of an unmanned ship in a flag state normally implies that the property law status of the ship will be governed by the law of that state.⁸⁴

The fact that an unmanned ship is operated by a state body appears not to make any difference for the application of the international rules on state immunity.⁸⁵

4. Master, seafarer, pilot, tugmaster, traffic controller, stowaway, pirate – all destined for the history books?

As unmanned ships no longer require a master or a crew on board, it would seem that the rules of law governing the status of these people will inevitably lose all relevance and would have to be consigned to the history of law. Closer examination on the other hand reveals that things are nonetheless not quite so simple.

⁷⁸ Convention on Facilitation of International Maritime Traffic 1965 (London 9 April 1965 as amended).

⁷⁹ Annex s 1.C.

⁸⁰ See the International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management Code) adopted by Resolution A.741(18) (as amended) art 1.2.1. From the historical point of view it is worth remembering the campaign to make the loadline compulsory and the first version of the Safety of Life at Sea (SOLAS) Convention, which was drawn up in response to the *Titanic* disaster.

⁸¹ Rule 1(e):

Whenever the Government concerned shall have determined that a vessel of special construction or purpose cannot comply fully with the provisions of any of these Rules with respect to the number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signalling appliances, such vessel shall comply with such other provisions in regard to the number, position, range or arc of visibility of lights or shapes, as well as to the disposition and characteristics of sound-signalling appliances, as her Government shall have determined to be the closest possible compliance with these Rules in respect of that vessel.

⁸² See eg Procedures for Port State Control arts 2.2.3, 2.6.2, 2.6.3 and 5.1.1.

⁸³ See Section 4.

⁸⁴ See inter alia S M Carbone *Conflicts de lois en droit maritime* (Leiden/Boston 2010) 277 *et seq.*

⁸⁵ See the International Convention for the Unification of Certain Rules Relating to the Immunity of State-owned Ships (Brussels 10 April 1926).

What about the captain? Once Master Under God, his position has been slowly downgraded during the past 100 years. His virtually unlimited powers to represent the owners in distant ports of call by agreeing business deals (sale and purchase of merchandise, recruiting crew and dockworkers, acquiring stores, effecting repairs, borrowing money, acting in law, etc) have been gradually eroded since the introduction of direct communications with head office (at first by telegraph, but now by an entire constellation of much faster technologies) and the appointment of agents so that now they have not much more than the power to take emergency measures, if the owners cannot be contacted or have for one reason or another disappeared from the scene. Better communications, automation, the services of pilots and the instructions of shore-based traffic managers, computer-controlled planning of container stows, etc mean that the captain has ever less autonomy, even when taking nautical and other operational decisions. He is no longer expected to take much responsibility for the ship's documents and the loading and discharge of cargo, whereas his duty to represent the authority of the flag state on board accounts for even less of his working day.⁸⁶ Once unmanned ships appear on the world's shipping lanes, this degradation will have reached its nadir, the captain will be banished from his ship. This once so considerable office will be no more than a romantic memory.

The same of course applies to what is regarded by some writers as a specific part of maritime law, so called 'Captain's Law',⁸⁷ ie the entirety of the legal rules that determine the legal status of the master. The legal powers exercised by the master on board ship will cease to have any object. No longer is there anybody on board who is responsible for the nautical command of the ship, or who may in case of emergency perform legal acts on behalf of the owners, exercise the employer's authority over a community of workers temporarily isolated from society, and who in certain circumstances represents authority (eg when recording and investigating crimes, recording births, marriages and deaths). The specific laws and legal codes existing in many countries concerning the maintenance of order and discipline on board and about the detection, identification and punishment of shipboard crimes appear not to have any object at all on board unmanned ships and to lose all relevance. The same lot seems to await the international standardization of the seafaring occupation, which is founded in documents such as the Maritime Labour Convention,⁸⁸ the STCW Convention,⁸⁹ the IMO Guidelines on the fair treatment of seafarers in the event of a maritime accident,⁹⁰ the Procedures for Port State Control (which among other things contain the guidelines for control of operational requirements concerning the operational proficiency of the crew, communication, ship drills, bridge operation, cargo operation, operation of the machinery, manuals and instructions, handling oil and oily mixtures from machinery spaces, etc), the International Safety Management Code⁹¹ (which formulates rules regarding the master's responsibility and authority, manning, qualifications of the crew, safety management skills of personnel aboard ships, emergency preparedness and similar), and the Casualty Investigation Code,⁹² which sets out rules about obtaining evidence from seafarers.

To the extent that the unmanned ship is operated or controlled from the shore, the question arises whether the shore-based vessel operator can in the current state of maritime law be regarded as the master, or more broadly, the commander of the ship and whether their colleagues are seafarers or crew members. Doubts have already been expressed as to whether the rules of the LOSC about the responsibilities of the flag state vis-à-vis the ship's crew can be applied directly to such operators.⁹³

⁸⁶ See in this connection inter alia the ECJ judgment in *Colegio de Oficiales de la Marina Mercante Española v Administración del Estado* (Case C-405/01) [2003] ECR I-10391.

⁸⁷ For more on 'Kapitänrecht' see H-J Puttfarcken *Seehandelsrecht* (Heidelberg 1997) 224-33 no 544-61.

⁸⁸ Maritime Labour Convention 2006 (Geneva 23 February 2006).

⁸⁹ Note 4.

⁹⁰ Guidelines on fair treatment of seafarers in the event of a maritime accident as adopted by IMO Resolution LEG.3(91) (27 April 2006).

⁹¹ Note 80.

⁹² Code of the International Standards and Recommended Practices for a Safety Investigation into a Marine Casualty or Marine Incident (Casualty Investigation Code) adopted by Resolution MSC.255(84) of 16 May 2008.

⁹³ See Section 3.

The STCW Convention, which determines the standards for the training, qualifications and certification of seafarers applies only to 'seafarers serving on board seagoing ships'.⁹⁴ The Maritime Labour Convention defines the 'seafarer' as 'any person who is employed or engaged or works in any capacity on board a ship to which this Convention applies'. The Guidelines on Fair Treatment⁹⁵ and the IMO Casualty Investigation Code⁹⁶ contain virtually identical definitions. Likewise national maritime laws on work performed at sea usually only apply to work that is performed aboard a ship.⁹⁷ There are, however, other national laws that simply define the master as any person to whom the authority of the ship is transferred or as the person who effectively exercises that authority, or as anybody instructed with the command of a vessel or who effectively has that command, as well as any person who replaces him.⁹⁸ Such broader definitions are aimed at the situation in which a temporarily incapacitated, absent, missing, or deceased captain is replaced by another officer. They are not directed at the new situation of unmanned shipping, but could in principle be applied to it.

Even so, quite apart from the interpretation of existing definitions, the question arises of whether it is relevant from the policy point of view to apply the principles of the specific status of seafarers to shore-based vessel controllers. The seafarer's status is based on the specific characteristics of being employed at sea, which include a markedly international environment, physical fitness requirements, safety risks, discipline, long-term presence at the place of work and the commensurate absence from home with limitations on family and social life, and the possibility of a physical transfer to another ship. A shore-based vessel controller does not have to face any of these factors. It is difficult to think of a valid reason why his employment should be governed by the specific rules of maritime law.

On the other hand a number of responsibilities that are currently incumbent on the master and his officers will inevitably be shifted to the shore-based vessel controller. The shore-based vessel controller at his control desk has a responsible job of carrying out the satisfactory handling of a very expensive means of transport which may be carrying a valuable cargo, and the avoidance of accidents that could cause considerable harm to the environment, the waterway, other traffic and participants and persons living on the coast and in ports. Just like the master, the shore-based vessel controller must have certain qualities, such as good judgement, the ability to communicate well with other human decision-makers (such as pilots and traffic managers), a cool head in emergencies, as well as the required technical knowledge of both nautical matters and IT.

Among the classic legal obligations that are likely to pass to the shore-based vessel controller will be, for example, the duty to maintain a proper look-out⁹⁹ and to proceed at a safe speed.¹⁰⁰ The rules concerned, which are set out in the Collision Regulations,¹⁰¹ are addressed to 'every vessel' and are in principle neutral in respect of the question of whether deck officers are on board or otherwise. It

⁹⁴ Article III.

⁹⁵ Article II.8.

⁹⁶ Article 2.17.

⁹⁷ See eg 46 U.S. Code §10101(3) and the Belgian Law (3 June 2007) art 28, 5°, 29. In the past Belgium recognized separate arrangements for the so-called *shoegangens*, these were seamen who performed work on a ship for an owner, or for the port services of a shipping company, without taking part in the sea voyage. For more about the various categories of seafarers in French law, see P Chaumette *Le contrat d'engagement maritime* (Paris 1993) 85 *et seq.* Labour law in France has been codified in the *Code des Transports*.

⁹⁸ See eg 46 U.S. Code §10101(1); UK Harbours, Docks and Piers Clauses Act 1847 s 3; the French Code des Transports art L5511-4; the Belgian Law (3 June 2007) art 28, 4°. Compare the following definitions of the shipmaster by Cartner, Fiske and T L Leiter in *The International Law of the Shipmaster* (London 2009) 3 §1.0, 86 §6.2):

- a natural person hired by contract *who lives on a vessel* (emphasis added) and manages it and its related matters while the vessel is navigating and carrying goods or performing services for freights or hire.
- (1) a natural person who (2) is responsible for a vessel (3) and all things and persons in it and is (4) responsible for enforcing the maritime laws of the flag state.

⁹⁹ Collision Regulations r 5.

¹⁰⁰ *ibid* r 6.

¹⁰¹ Some aspects of the application of the COLREGs to UMVs are discussed in M R Benjamin, J A Curcio *COLREGS-Based Navigation of Autonomous Marine Vehicles* (2004); Brown, Gaskell (n 5) 116–21; F Safari, B Sage *Legal and Liability Analysis for Remote Controlled Vessels* MUNIN www.unmanned-ship.org.

goes without saying that the shore-based vessel controller must maintain a look-out and proceed at an appropriate speed.¹⁰² More of a matter of principle though is how the general standard of good seamanship (ie maritime common sense) must be given form. Nothing in the COLREGs exempts 'any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with [their] Rules or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case'.¹⁰³ In construing and complying with the Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from the Rules necessary to avoid immediate danger.¹⁰⁴ What we must ask is whether a shore-based vessel controller can be reasonably expected to assume this duty of responding flexibly to changing circumstances? As mentioned above he lacks the direct experience of being on the bridge.¹⁰⁵

On the other hand, however, it has also been pointed out that the position of the shore-based vessel controller is very similar to that of the officer of the watch who must navigate in poor visibility and is reliant on the radar and who might then – worse still – be faced with a defective radar.¹⁰⁶ Furthermore as automation of navigation and collision avoidance functions increasingly take the human watch officer out of the loop, the functional difference between an unmanned marine vehicle and a manned vessel with a monitoring watch officer is starting to fade even today.¹⁰⁷ Indeed many merchant ships and leisure craft are already equipped with automated navigational systems and auto-steering devices, comparable with the automatic pilot on aircraft. When the command post of the shore-based vessel controller is laid out in the same way as the bridge of a ship, unmanned navigation would appear to be not so far from the conditions of modern manned navigation. Less certain is whether autonomous ships directed by artificial intelligence will ever be able to meet standards of good seamanship. According to Nick Gaskell as long as the SOLAS Convention remains unamended, it will continue to be a primary obstacle, as this Convention requires that it must be possible to switch over to manual steering with the assistance of a helmsman.¹⁰⁸

Flag states must require the master and the operator (where this latter is to be construed as meaning a ship owner, ship manager or bare boat charterer¹⁰⁹) of a ship to report to the affected state without delay when that ship has been involved in a maritime casualty resulting in a wreck.¹¹⁰ Should it concern an unmanned ship, the operator of the ship must still comply with this obligation and the question arises whether the lawmaker must also impose a direct duty to report to shore-based vessel controllers.

¹⁰² For more about the implied requirement of human monitoring in the COLREGs see Brown, Gaskell (n 5) 118.

¹⁰³ Collision Regulations r 2(a).

¹⁰⁴ *ibid* r 2(b).

¹⁰⁵ See Section 1.

¹⁰⁶ See R McLaughlin (n 6) 100, 111:

This then leads us to the second point – USVs that are remote from their controller, or are fully autonomous, will not be 'dumb'. They will have sensors – such as radar – just as manned vessels do, and will be controlled in accordance with the data these sensors reveal. To my mind, there is little distinction between a manned vessel navigating through restricted visibility under the control of an Officer of the Watch (OOV) standing on the bridge with his or her head buried in the radar, and a controller doing the same by reading the radar picture delivered instantaneously to their physically remote control station by the ship's sensor suite. To take the example further, if it is highly restricted visibility, the radar is unserviceable, and the OOV is conducting collision avoidance through squinted eyes and peeled ears listening for the required restricted visibility sound signals of other vessels, there is no reason why a controller ashore who is receiving the same – if not actually enhanced – sensor information from the USV cannot conduct the navigation of the ship with the same degree of accuracy and safety.

¹⁰⁷ C H Allen 'The Seabots are Coming Here: Should they be Treated as "Vessels"?' [2012] *The Journal of Navigation* 749–51.

¹⁰⁸ See Brown, Gaskell (n 5) 113. The International Convention for the Safety of Life at Sea 1974 (London 1 November 1974 as amended) (SOLAS) reg V/24 currently reads:

1. In areas of high traffic density, in conditions of restricted visibility and in all other hazardous navigational situations where heading and/or track control systems are in use, it shall be possible to establish manual control of the ship's steering immediately.
2. In circumstances as above, the officer in charge of the navigational watch shall have available without delay the services of a qualified helmsperson who shall be ready at all times to take over steering control.
3. The changeover from automatic to manual steering and vice versa shall be made by or under the supervision of a responsible officer.
4. The manual steering shall be tested after prolonged use of heading and/or track control systems, and before entering areas where navigation demands special caution.

¹⁰⁹ See the definition in the Nairobi Wreck Removal Convention art 1.9.

¹¹⁰ *ibid* art 5.

It will be even more important to revise the International Safety Management Code, which already imposes obligations relating to the shore-based personnel of shipping companies so that the work of shore-based controllers is given a proper framework, with clear standards regarding organizational structure, internal hierarchies, lines of communication and the clearing of information, as well as qualifications, certification and emergency procedures. As for Port State Control it must be assumed that the shore-based vessel controllers will also be able to demand an inspection.¹¹¹ The powers of the Port State Control authorities to inspect the ships controlled by a shore-based organization in another country will have to be clearly defined.

As there is no longer any crew on board, the extensive body of rules about the physical ship's documents becomes in principle quite pointless. There is after all nobody on board to keep up to date the mountain of papers on board, including the certificate of registry, safety certificates (including the safety management certificate and the copy of the document of compliance required by the safety management rules), the tonnage certificates, the minimum safe manning document, manuals and instructions, bills of lading, the manifest, the crew list, the oil log, the log books, the charts, etc and to submit these for inspection to port officials when so requested. Some documents such as the crew lists and the charts will automatically become obsolete or pointless. But would it not be relevant to keep an official record of who acts as shore-based vessel controller, and make it compulsory that these persons have the most recent digital charts? Likewise it would seem necessary to ensure that the documents identifying the ship and recording its size and safety condition are also fully digitized, and should be made available to the parties concerned in an appropriate electronic form. New regulations will be necessary to achieve this, just as the collection of evidence about the navigation of the ship and the actions taken by the shore-based vessel controller will be (where the latter will replace the logbook and the captain's report). Modern maritime law already includes rules about the installation of voyage data recorders (VDR)¹¹² on board, but these will have to be revised and generalized so that the actions of shore-based controllers are fully recorded and made accessible. By analogy with VDRs, it could be thought necessary to record details such as date and time, ship's position, speed, heading, echo sounder depth information, rudder order and response, engine and thruster order and response, hull openings status, accelerations and hull stresses, wind speed and direction, AIS data, rolling motion, VDR configuration data and in general the entirety of the communications between the shore-based vessel controller and the ship and the status of the means of communication. Likewise the ownership, conservation time, and evidential value of such digitally collected data probably deserve closer regulation, just as do the right of access to and the conditions subject to which these may be used, for example in connection with the protection of personal data.

Speaking of the papers kept on board, what about the tradition of the publication of special guides to maritime law for ship masters,¹¹³ which presumably will have to be continued in a special series for shore-based vessel controllers? Finally, what will happen to the service of trial documents on the master on board the ship and his power to act in law (after all the national laws of many countries recognize such possibilities¹¹⁴)? On the other hand the relevance of involving the shore-based vessel controller in legal proceedings is perhaps doubtful. Perhaps it would better to extend the powers of legal representative to the ship's agent. This question is already regulated by law in some jurisdictions.¹¹⁵

¹¹¹ See Procedures for Port State Control (adopted by Resolution A.1052(27) 30 November 2011) art 2.1.2.

¹¹² See SOLAS Convention Annex chap V reg 20; Recommendation on performance standards for voyage data recorders (VDRs) (Resolution A.861(20)) as amended by Resolution MSC.214(81)); Revised performance standards for shipborne voyage data recorders (VDRs) (Resolution MSC.333(90)); Performance standards for shipborne simplified voyage data recorders (S-VDRs) (Resolution MSC.163(78) as amended by Resolution MSC.214(81)); IMO Guidelines on Voyage Data Recorder (VDR) ownership and recovery (Maritime Safety Committee Circular 1024, 29 May 2002).

¹¹³ See eg J R Aragon *Shipmaster's Handbook on Ship's Business* (Centreville Maryland 1988); H Holman *A Handy Book for Shipowners & Masters* (London 1948); F N Hopkins, G G Watkins *Business and Law for the Shipmaster* (Glasgow 1979).

¹¹⁴ See and compare the *German Handelsgesetzbuch* §601, the Dutch Civil Procedure Code art 59, the Norwegian Maritime Code s 137; the Swiss *Loi fédérale sur la navigation maritime sous pavillon suisse* art 55; the Italian *Codice della Navigazione* art 309, the Chilean *Código de comercio* arts 907, 914–16 and the *Proeve van Belgisch Scheepvaartwetboek* art 5.10, 5.14.

¹¹⁵ See eg the Chilean *Código de comercio* art 922, the French *Décret n 69-679 du 19 juin 1969 relatif à l'armement et aux ventes maritimes* art 10, 18 and the Italian *Codice della Navigazione* art 288.

All the foregoing considerations are based on the assumption that there will be no seafarers left on board. Here it is necessary to examine this assumption.

The first observation concerns the organization of passenger transport. It would seem self-evident that the operator of a ship that controls itself or is controlled or guided from the shore, would place personnel on board to serve the passengers and to maintain order during boarding and landing and during the voyage.¹¹⁶ It would then appear to be logical for maritime law to confer certain powers on one of these employees, for example for maintaining order, recording crimes, and drawing up records relating to civil status. Such an employee would then be invested with a remnant of the master's public function. To make this possible the internal maritime law of most countries would probably have to be amended.

A further particularity arises in connection with persons who come on board to prepare the satisfactory arrival and departure from a port. In a current European project it is assumed that a bulk carrier about to call at or depart from a port will still make use of an 'on-board bridge team'.¹¹⁷ If this is to be the case, existing national laws and local regulations regarding traffic organization will probably need amending. A possibly obligatory intervention of humans for bringing the ship in and out of the port would constitute a remarkable extension of the age-old rule that the captain must be personally present on the bridge upon entering and leaving ports.¹¹⁸

The status of the pilot is not defined in any general international convention, but is defined in local regulations. In the classic view, and subject to specific regulatory exception, the pilot is an advisor who assists the captain on board with advice about navigation in the pilotage waters in the approaches to ports and in waterways. Efficient pilotage depends upon the effectiveness of the communications and information exchanges between the pilot, the master and the bridge personnel and upon the mutual understanding each has of the functions and duties of the other.¹¹⁹ There are also places where the pilot gives his advice from the shore, by means of radio communications. In that case the pilot continues to act as advisor. Whatever the case may be, the growth of unmanned merchant shipping will probably give rise to major changes in the organization of pilotage services and the profession of pilots. The direction these developments will take depends largely on how the technology develops. There is certainly no doubt that a shore-based vessel controller will benefit from the assistance of a local guide.

To the extent that unmanned ships will go on making use of tug assistance upon entering and leaving ports, the question arises of who has the command of the tow. As maritime law now stands it is usually the master of the seagoing ship. Whether this arrangement will continue will depend on how the technology develops. Contractual clauses, national law and local regulations will have to be adjusted. There are no treaty arrangements governing this matter.

In most ports ships are assisted by vessel traffic services (or vessel traffic management and information services).¹²⁰ The traffic controllers give the master, deck officers and pilot information and advice and are not responsible for controlling the ship. National or local rules in some places do give the traffic controllers the authority to impose orders in exceptional circumstances, but these may only be results-oriented. Likewise harbour masters and their subordinates may impose instructions, which, if not complied with, are in general subject to criminal prosecution. The organization of the traffic flows in and around ports will require far-reaching adjustments. Although this might seem improbable to those familiar with current practice, it may be expected that traffic management will

¹¹⁶ With respect to UAVs, compare S A Kaiser 'Legal Aspects of Unmanned Aerial Vehicles' [2006] *Zeitschrift für Luft- und Weltraumrecht* 344, 362.

¹¹⁷ See www.unmanned-ship.org.

¹¹⁸ See the French *Ordonnance de la Marine* 1681 T. I B. II art 13 and the French *Code de Commerce* 1807 art 227. The rule was adopted into various other codifications.

¹¹⁹ Recommendation on training and certification and on operational procedures for maritime pilots other than deep sea pilots, adopted by IMO Resolution A.960(23) (5 December 2003) Annex 2 art 1.

¹²⁰ Guidelines for Vessel Traffic Services (adopted by IMO Resolution A 20/Res. 857, 27 November 1997).

be increasingly computer-controlled. This will certainly be the case for the reporting of ship, cargo and passenger-related data, but will probably also be extended to the navigational manoeuvres themselves (compare the existing AIS system). To the extent that VTS will continue to make use of people, new rules will become necessary for the training and certification of VTS personnel,¹²¹ the interaction, communications and hierarchy between the traffic management and the shore-based vessel controllers, for the reporting duties of masters in connection with hazards, defects and pollution and about the capture, secure storage, retrieval and presentation of VTS-related information.¹²²

Despite the parallels, the role of the shore-based vessel controller himself cannot be assimilated to that of a pilot, a shore-based pilot, a VTS operator or traffic controller, or a harbour master,¹²³ and it does not seem sensible to apply the relevant regulations to such an operator simply by analogy. We will return to his civil liability below.¹²⁴ In the meantime what about the criminal liability? At present breaches of navigational and port regulations are subject to criminal sanctions. Breaches of these regulations and of the orders or prohibitions imposed by the harbour master or other authorized port personnel may result in fines, imprisonment and/or the detention of the ship. The effective authority of the regulations and the competent officials flow from this sanctioning mechanism. What, however, is the situation if the owner of the ship and the shore-based vessel controller are located in some far-away country, or if the ship has no controller and is an entirely autonomous participant in the traffic? How can breaches then be punished? Is there any point in making the programmer of an autonomous ship, or the ship itself, criminally liable?¹²⁵ Alternatively is it that this difficulty can only be resolved by radical reorganization, so that the port authority itself, or one or more service providers with clearly designated natural persons, take control of the ship and guide it in and out of the port? Perhaps there is a need for a new kind of pilot who remains in a shore station and guides the ship in, or at least supervises it, and takes direct action when necessary. New international and national regulations on the qualifications, training, certification, refresher training, task and liability of such shore-based operators thus appear to be necessary.

Ironically, apart from the possible passengers on board an unmanned ship, it appears that the only person who would retain his status in maritime law is the stowaway. However unmanned USVs might be, it is probably illusory to think that they will not be boarded by stowaways. According to the definitions of the 1957 Convention on Stowaways¹²⁶ and IMO's 2011 Stowaway Guidelines,¹²⁷ the stowaway is the person who goes on board without the consent of the shipowner or the master.¹²⁸ Even though the latter has disappeared from the scene, the absence of permission to go

¹²¹ IMO MSC/Circ 1065 (13 December 2002).

¹²² See in connection with the latter The International Association of Marine Aids to Navigation and Lighthouse Authorities *IALA VTS Manual 2012* (Saint-Germain en Laye 2012) chap 16.

¹²³ Compare on ground-based pilots of UAVs and air traffic controllers S A Kaiser 'Legal Aspects of Unmanned Aerial Vehicles' [2006] *Zeitschrift für Luft- und Weltraumrecht* 344, 356.

¹²⁴ See Section 5.

¹²⁵ See, admittedly not specifically in connection with unmanned ships, G Hallevy (n 6). The author however gives no attention to the purpose and social utility of such penalization.

¹²⁶ International Convention relating to Stowaways (Brussels 10 October 1957) (not yet in force).

¹²⁷ Guidelines on the Prevention of Access by Stowaways and the Allocation of Responsibilities to Seek the Successful Resolution of Stowaway Cases (adopted by Resolution FAL.11(37) 9 September 2011).

¹²⁸ See the following definitions:

– Stowaway Convention 1957 art 1:

'Stowaway' means a person who, at any port or place in the vicinity thereof, secretes himself in a ship without the consent of the shipowner or the Master or any other person in charge of the ship and who is on board after the ship has left that port or place.

– IMO Guidelines 2011 art 2:

1 Attempted stowaway. A person who is secreted on a ship, or in cargo which is subsequently loaded on the ship, without the consent of the shipowner or the master or any other responsible person, and who is detected on board the ship before it has departed from the port.

6 Stowaway. A person who is secreted on a ship, or in cargo which is subsequently loaded on the ship, without the consent of the shipowner or the master or any other responsible person and who is detected on board the ship after it has departed from a port, or in the cargo while unloading it in the port of arrival, and is reported as a stowaway by the master to the appropriate authorities.

on board is sufficient to class the intruder as a stowaway. Nonetheless this does not mean that the current law on stowaways will be able to continue in effect unamended, precisely because there is no master on board who can take measures. How stowaways on board unmanned ships are to be treated will certainly be a matter for further consideration. Can physical measures be taken from a distance? What legal framework must be created for such and what about human rights?

In the age of unmanned shipping, it would be naive to expect that pirates and terrorists will disappear from the high seas (perhaps they will even think that such ships will be a new and softer target). Whether the hacker of the IT system controlling an unmanned vessel is a pirate in the meaning of the UN Convention on the Law of the Sea is not so clear.¹²⁹ What appears to be less doubtful though is that the 2005 SUA Convention could be applicable,¹³⁰ although the provisions of this Convention about the powers of the master¹³¹ once again appear to be impracticable.

5. Phantom contracts and phantom liability?

For McLaughlin, who previously examined the law relating to unmanned military vehicles at sea, the normal rules of liability can continue to function as long as there is (1) a traceable path of control over and responsibility for their employment (as distinct from any requirement for there to be an identifiable individual to be allocated criminal liability for an unlawful consequence and who would be subject to criminal sanction as a result – this is a different concept); and (2) recognition of the scope for error or mistake. The author then argues as follows:

Only when the line of control and/or responsibility becomes uncertain or unidentifiable at law does the governance offered by general principles potentially become fundamentally inadequate. Even in this situation, however, it is not at all clear that because an applicable general principle cannot clearly identify the criminally liable human(s), it then necessarily follows that there is no responsible human. Just because – in a future of completely autonomous unmanned combat surface vehicles (UCSV) – there is no individual who physically pushes the required button which launches missiles at a truck ashore carrying refugees, does not mean that there is no line of responsibility.¹³²

The logic of this is perfectly clear. Even so the application of existing rules on contractual and extra-contractual liability to unmanned shipping merits further consideration.

To begin with the charter party, which determines how the ship is operated, there is nothing to stop the various types of charter party continuing to play a role. The fact that ships will in future perform their tasks without anybody on board does not appear to have an essential impact on these contracts. What will be required are changes to the drafting of the internationally current standard contracts. This will apply in particular to the detailed arrangements governing the distribution of competences, expenses and risks between the owner and the charterer about the recruitment, functioning and replacement of the master and the other crew members. Under a bareboat charter the shore-based vessel controller will logically enough be contracted by the charterer, while under a time charter it will be the owner who makes the controller available, although the charterer must be able to give the controller the necessary instructions. In a voyage charter the controller will once again be supplied by the owner.

How unmanned navigation will be integrated into the ship and crew management industry is something of an open question. It would not be surprising if the provision of shore-based vessel controllers were to develop into a new service, which might possibly become a separate activity (both as contractor or sub-contractor), for which specific international standard contracts will be drafted. For example, it would seem self-evident that the ship manager would reject liability for the mistakes of shore-based vessel controller. New international conventions in this field appear to be unnecessary,

¹²⁹ See Section 3.

¹³⁰ See the description of the offences in the 2005 SUA Convention art 3, *3bis*, *3ter* and *3quater* which do not assume that all acts are committed on board.

¹³¹ *ibid* art 8.

¹³² R McLaughlin (n 6) 100, 103–04.

as the whole subject of chartering and ship management is, to the general satisfaction of all concerned, left to freedom of contract. National lawmakers, who have developed a non-mandatory framework for chartering, shall nonetheless have to amend it.

As the operation of a ship is often a contractual collaboration between the registered owner, one or more charterers and one or more managers, some national legislatures have introduced general rules on the liability or joint liability of these parties vis-à-vis third parties.¹³³ The circumstance that ships no longer have a crew on board does not appear to undermine these rules *per se*. There are no general arrangements agreed by international convention in this respect.

The limitation of the liability of shipowners is governed by the LLMC Convention, the formulation of which appears to be likewise neutral in respect of the presence or otherwise of a master or a crew on board. If a claim subject to limitation is made against a shore-based vessel controller for whose act, neglect or default the shipowner is responsible, the controller will be entitled to avail himself of the right to limit.¹³⁴ But the LLMC Convention may not govern employment-related claims by a controller who is a servant of the shipowner.¹³⁵

As we assume that unmanned ships will also be used to carry goods and persons, there will be a need for contracts of carriage. All in all the rules concerned will be able to remain in effect. Admittedly the master in the old maritime law was a pivotal figure, for it was he who signed the bill of lading.¹³⁶ It was already accepted in the Hague Rules that this transport document (which includes the description of the goods taken on board) could be issued either by the master, or by the carrier, or by an agent.¹³⁷ In the Hamburg Rules the signing of the bill of lading by the master is expressly mentioned as one possibility.¹³⁸ In the Rotterdam Rules the master is pushed more into the background, his possible intervention in the issue of a transport document is no longer even mentioned.¹³⁹ The fact that the master disappears from the scene in the event of unmanned merchant shipping does of course not mean that no valid transport documents can be issued. Indeed it may be expected that these documents will increasingly, if not exclusively, be issued in electronic form.

The duty of the carrier to apply due diligence to making the ship seaworthy, which is a fundamental element of the Hague Rules¹⁴⁰ and the Rotterdam Rules,¹⁴¹ will, in the light of the available case law about the general state of the ship, its navigational equipment such as charts, radar installations and competence of the crew,¹⁴² imply that among other things the guiding IT mechanism and the shore-based vessel controller must function satisfactorily. Undoubtedly case law will be able to give appropriate effect to the relevant provisions.

It follows then that there can be no doubt that a maritime carrier will be vicariously liable for the errors of the shore-based vessel controller¹⁴³ working on his behalf. This will apply under the Hague Rules, the Hamburg Rules as well as the Rotterdam Rules. However, the exoneration in favour of the carrier provided for in the Hague Rules for error in the navigation or in the management of the ship¹⁴⁴

¹³³ Compare the Belgian *Code de Commerce* B. II art 46; the German *Handelsgesetzbuch* §480; France's *Code des Transports* art L5412-1; the Dutch *Burgerlijk Wetboek* (Civil Code) art 8:360; Italy's *Codice della navigazione* art 274 and the Norwegian *Lov om sjøfarten* art 151.

¹³⁴ See LLMC Convention art 1.4.

¹³⁵ See LLMC Convention art 3(e).

¹³⁶ See eg the French *Ordonnance de la Marine* T. II B. III art 1 *et seq*; and the 1807 French Code of Commerce art 282.

¹³⁷ Article 3.3. That the bill of lading did not necessarily have to be signed by the master, but that an agent could do as well, was established case law in France even before 1900 (see G Ripert *Droit maritime* (Paris 1952) vol II 372-73 no 1460).

¹³⁸ Article 14(2).

¹³⁹ Master and crew are still featured in arts 4.1(b), 18(b) and 19.4 all of which concern liability.

¹⁴⁰ Article 3.1. With respect to the situation under the Hamburg Rules, see inter alia S Ping-fat *Carrier's Liability under the Hague, Hague-Visby and Hamburg Rules* (The Hague/London/New York 2002) 63-64.

¹⁴¹ Article 14.

¹⁴² See eg the case law discussed in W Tetley *Marine Cargo Claims* (4th edn Cowansville Québec 2008) vol I 875 *et seq* and T Nikaki 'The obligations of carriers to provide seaworthy ships and exercise care' in R Thomas (ed) *A New Convention for the Carriage of Goods by Sea – The Rotterdam Rules* (Witney 2009) 89 *et seq*.

¹⁴³ Compare the Hague-Visby Rules art 4.2(q) and (indirectly) Rotterdam Rules art 18.

¹⁴⁴ Article 4.2(a).

will remain in effect, because such does not only apply to the master but also to each servant of the carrier, of which it may be supposed that the shore-based vessel controller is one. However, this specific exclusion of liability has been entirely omitted from the Hamburg Rules and the Rotterdam Rules.

The international conventions for carriage by sea do not determine whether the personnel of the carrier can be held directly liable by the person sustaining the loss.¹⁴⁵ To the extent that such might be possible, the shore-based controller will probably be able to invoke the same exclusions and limitations of liability as the maritime carrier (on the grounds of either a legal or 'automatic'¹⁴⁶ or a contractually agreed Himalaya clause).

Should, however, the ship be controlled or monitored by a third-party service provider who is not a servant of the carrier, a number of legal difficulties arise. Although there can be no doubt that the carrier would remain liable for the errors of the shore-based vessel controller, it is not so certain that under the Rotterdam Rules the latter could be directly approached by the cargo interests. If the controller is an independent provider of nautical technical services who himself assumes no responsibilities for the cargo under a specific contract for carriage, he can hardly be regarded as a 'maritime performing party' and the Rotterdam Rules then offer no basis for a direct claim against such a controller.¹⁴⁷ Similarly under the Hamburg Rules such a carrier can probably not be regarded as an 'actual carrier'.¹⁴⁸ Whether or not any direct action against an independent shore-based vessel controller is possible will depend on contractual clauses and national law. The automatic Himalaya protection set out in the maritime transport conventions is in any case not applicable.¹⁴⁹ This long-standing question is, however, in no way specific to the hypothesis of unmanned merchant shipping.

It is difficult to predict how a breakthrough of unmanned merchant shipping will affect the role of the ship's agent. As the contract of the ship's agent is entirely left to freedom of contract in nearly all countries and is moreover governed by international and local standard contractual clauses, the elaboration of new regulations does not appear to deserve priority attention.

The liability of stevedores and terminal operators is regulated internationally in the Terminal Operators Convention,¹⁵⁰ which, however, will probably never come into effect. Under the Rotterdam Rules, which will perhaps still come into force at a later date, stevedores and terminal operators must be regarded as maritime performing parties,¹⁵¹ who can be held directly liable by the cargo interests, but who also may resort to the same arguments in their defence as the maritime carrier.¹⁵² As port technology now stands, container terminals at which the boxes are handled by unmanned, computer-controlled vehicles and stackers are no longer a rarity. There are even terminals in operation where the shore cranes are manually operated from a console equipped with video screens, and not from the cab of the crane. There is nothing to stop such crane drivers operating cranes in another country in the future. This appears in principle not to make any difference to the liability of the terminal operator, who is a maritime performing party under the Rotterdam Rules.¹⁵³

¹⁴⁵ Rotterdam Rules art 19.4.

¹⁴⁶ Hague-Visby Rules art 4*bis* (which does not apply to independent contractors), Hamburg Rules art 7.2, 10.2 (which likewise only mention the servant and the agent) and Rotterdam Rules art 4.1 (which not only mentions the master, crew or 'any other person that performs services on board the ship' but also a maritime performing party and the employees of the carrier or a maritime performing party).

¹⁴⁷ Rotterdam Rules art 19 and definitions in art 1.6. For a further analysis of the relevant provisions of the Rotterdam Rules see M F Sturley, T Fujita and G van der Ziel *The Rotterdam Rules* (London 2010) 131 *et seq*, no 5.139 *et seq*; R Thomas 'An analysis of the liability regime of carriers and maritime performing parties' in Thomas (n 142) 52 *et seq*.

¹⁴⁸ Hamburg Rules art 10 and definition in art 1.2.

¹⁴⁹ This stays the same in the Rotterdam Rules, art 4 of which is in fact also applicable to independent contractors. Independent contractors who are not a maritime performing party, or employees of a maritime performing party, or employed on board, fall through the holes in the net.

¹⁵⁰ United Nations Convention on the Liability of Operators of Transport Terminals in International Trade (Vienna 1991).

¹⁵¹ See further S Niessen 'A new era for terminal operators' [2014] *European Transport Law* 25–30.

¹⁵² Rotterdam Rules art 19.

¹⁵³ See Rotterdam Rules art 5.2 for the irrelevance of nationality.

Nor does the introduction of crewless ships appears to make any impact on the international rules on the liability of the passenger carrier.¹⁵⁴

Collision law also appears to be able to stand up well against the arrival of unmanned ships. The 1910 Collision Convention, which is the most successful private law harmonization Convention of the Comité Maritime International (CMI), governs the liability for collisions on the basis of the errors of ships,¹⁵⁵ and not the errors of the master and the other crew members (even though these are of course the cause of the collision). The rules of the convention also apply when the collision is caused by the error of a pilot, even when the use of this person's services is compulsory.¹⁵⁶ Should the collision be caused by the error of a shore-based vessel controller nothing will change regarding liability.¹⁵⁷ The provisions of the Collision Convention about the death of or personal injury to persons on board¹⁵⁸ will (to a large extent) lose their relevance, just like the duty incumbent on the master to go to the aid of ships, crews and passengers in distress.¹⁵⁹

The rules of the special conventions relating to pollution damage appear to remain entirely unaffected. Nothing changes with respect to the strict (but limited) liability and insurance obligation incumbent on the owner of an oil tanker. Claims are channelled against the owner and no claim for pollution damage against the shore-based vessel controller is possible, either because he is a servant of the owner, or because he must be regarded as '[an]other person who, without being a member of the crew, performs services for the ship'.¹⁶⁰ The 1992 Fund Convention 1992¹⁶¹ and the Supplementary Fund Protocol¹⁶² appear to be likewise unaffected. Moreover the observations regarding CLC 1992 appear to be applicable in respect of the HNS Convention.¹⁶³ The Bunkers Convention, which does not provide for the establishment of a fund, does not adopt the channelling approach, although this convention also appears to be capable of surviving unscathed in the era of unmanned merchant shipping.

As it may be assumed that unmanned ships will come into danger, the salvage rules will also continue to be useful. The master's authority to sign salvage agreements on behalf of the owners and the cargo interests,¹⁶⁴ however, becomes purely academic, just as his duty to help persons in distress at sea¹⁶⁵ and to work with the salvor to prevent or limit environmental damage (although this latter obligation continues to rest on the owner of the ship).¹⁶⁶ Likewise national provisions about the right of the master and crew to a share of the salvage fee¹⁶⁷ also lose their relevance. Although it is quite conceivable that the shore-based vessel operator might be given the authority to conclude a salvage contract, and it is evident that he must cooperate with the salvage operation, receiving a share in the salvage fee seems excessive. Finally the rules governing the salvage of persons¹⁶⁸ will lose practical relevance as fewer and fewer people go to sea.

¹⁵⁴ Convention relating to the Carriage of Passengers and their Luggage by Sea (Athens 13 December 1974 as amended).

¹⁵⁵ Article 3 en 4.

¹⁵⁶ Article 5.

¹⁵⁷ However compare Brown, Gaskell vol Two (n 5) 131 where it is stated that it seems unlikely that the Convention will apply to AUVs.

¹⁵⁸ Article 4.

¹⁵⁹ Article 8.

¹⁶⁰ CLC 1992 art III.4(a)(b).

¹⁶¹ International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1992 (London 27 November 1992 as amended).

¹⁶² Protocol of 2003 to the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1992 (London 16 May 2003).

¹⁶³ See art 7.5(a)(b).

¹⁶⁴ Salvage Convention 1989 art 6(2). See further F D Rose *Kennedy and Rose on the Law of Salvage* (6th edn London 2002) 384–389, no 814–22.

¹⁶⁵ Salvage Convention 1910 art 11; Salvage Convention 1989 art 10.

¹⁶⁶ Salvage Convention 1989 art 8(2).

¹⁶⁷ Salvage Convention 1910 art 6; Salvage Convention 1989 art 15(2).

¹⁶⁸ Salvage Convention 1910 9; Salvage Convention 1989 16.

General average presupposes a voluntary sacrifice or expense.¹⁶⁹ Under the York-Antwerp Rules and various national laws a decision by the master is not essential as such,¹⁷⁰ so that the intervention of a shore-based controller could be considered. For example, it cannot be excluded that an unmanned ship might have to call in a port of refuge (although whether cargo could be remotely jettisoned is another question; perhaps in the future this could become technically possible for containers carried on deck). In the absence of crew there will be no reason to admit as general average wages of the crew in the event of a prolongation of the voyage occasioned by a ship entering a port of refuge.¹⁷¹

The arrest of ships on the grounds of unpaid debts can continue unhindered, although it will be understood that an arrest by reason of arrears in the pay of the master, officers and crew or by reason of master's disbursements¹⁷² will no longer have any object. The implementation and maintenance of the arrest will no doubt necessitate some adjustments to national procedural laws. Legislation will also be required to regulate the procedures for the forced sale of an unmanned ship and in particular of the necessary IT control system. But there does not seem to arise a pressing need to amend any of the international ship arrest conventions.

A similar conclusion is reached regarding the international rules of liens and mortgages on ships. The principles remain in effect, but the lien arising from claims for wages and master's disbursements¹⁷³ will become obsolete. The introduction of a lien for the pay claims of shore-based vessel controllers appears not to be defensible. The lien on the ship for wages claims was introduced because of social and humanitarian considerations and in particular because of the risk to which seafarers were exposed by reason of the danger of their work, the frequent application of foreign law and the danger of being stranded in a foreign country in the event of the sale of the ship for the settlement of debts.¹⁷⁴ None of these concerns appear to be relevant to the employment of shore-based vessel controllers. This applies equally to the conservatory arrest of the ship just considered above.

All things considered it appears that with regard to the liability of the ship owner and operator relatively little will have to change. Nonetheless fundamental policy questions may well arise regarding a unmanned merchant service. As pointed out above¹⁷⁵ all kinds of new risks will certainly come into being. The insurability of the risk will undoubtedly be a major concern particularly during the first phase of the introduction of unmanned ships. The way in which roles will be shared between H&M and P&I cover is not yet clear. The introduction of fundamentally new liability rules may become the subject of political discussion. Should a breakthrough of unmanned ships be accompanied by the introduction of a generalized objective liability on the part of the owner, combined with a duty to insure and a direct claim by the party sustaining the loss? Would it be preferable to have everything turn on strict liability for ships controlled by artificial intelligence? Must the shore-based vessel controller be protected against unlimited personal liability? Would there be reason to make software and hardware developers, system engineers and manufacturers subject to a special product liability? Furthermore how will their liability be demarcated in respect of the user and the shore-based vessel controller? Are special rules of evidence and time bars necessary? The list of potential policy questions is endless, but it is at present probably still too early to try and answer them.

¹⁶⁹ York-Antwerp Rules 1994 (Sydney 8 October 1994) r A.

¹⁷⁰ See J H S Cooke, R R Cornah *Lowndes and Rudolf. The Law of General Average and The York-Antwerp Rules* (13th edn London 2008) 83–86 nos A.10–A.15 and the references to case law; W Tetley (n 11) 368–69.

¹⁷¹ York-Antwerp Rules 1994 r XI.

¹⁷² Compare Ship Arrest Convention 1952 art 1(1)(m)(n); Ship Arrest Convention 1999 art 1.1(o)(p).

¹⁷³ Compare Maritime Liens and Mortgages Convention 1926 art 2.2, 2.5; Maritime Liens and Mortgages Convention 1967 art 4.1, i); Maritime Liens and Mortgages Convention 1993 art 4.1(a).

¹⁷⁴ See R J C Flach *Scheepsvoorrechten* (Deventer 2001) 86–88.

¹⁷⁵ See Section 1.

6. Does Maritime Law still have a point?

The sloganesque 'No seafarers no sea trade'¹⁷⁶ view expressed by the eminent maritime lawyer Puttfarken in 1997 appears at the very least to be fundamentally mistaken. The impact on the shipping industry of the replacement within the proximate future of the hard work of masters, ships' officers and crews by computer programs and artificial intelligence, assisted at most by shore-based vessel controllers has the potential to change the social and economic parameters of the shipping industry as much as the introduction of steel construction and steam propulsion did in the nineteenth century. On the other hand maritime law with its long history appears on first examination to be relatively well armed for this technological innovation, and the necessary and undoubtedly extensive adaptations of existing public and private maritime law will be unlikely to bring about a revolution. Maritime law will not die out but will enter a new phase of development, once again proof of the continuity and necessity of this branch of the law.

¹⁷⁶ Puttfarken (n 87) 23 no 562.