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Ms Luci Carey

Research Associate, Centre for Maritime Law, Faculty of Law, NUS

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All Hands off Deck? The Legal Barriers to Autonomous Ships

*Luci Carey**

Abstract

Disruptive technology is affecting all industries and shipping is no exception. Commercial autonomous ships are soon to be realised but before they can operate internationally, there are significant legal hurdles to overcome. This article considers some of these hurdles from a common law perspective. First, the lack of human presence on-board may render the proposed autonomous ships unseaworthy thereby removing the benefit of the exclusions in the Hague and Hague-Visby Rules and potentially voiding marine insurance policies. Second, these ships may not be able to comply with COLREGs. Third, the traditional role of the shipmaster will disappear and the associated legal duties and liabilities will disperse to other actors. Finally, compulsory pilotage laws vary not only from country to country, but also from port to port meaning that autonomous ships may not be permitted to berth in some ports. Thus, their usefulness as cargo-carrying vessels will be limited unless these issues are resolved at an international level.

1 Introduction

Autonomous or unmanned ships will soon become a reality.¹ This will cause significant disruption to current maritime legal regimes. International maritime law has proved flexible

* MA(Hons); LLB (Hons) Research Associate, Centre for Maritime Law, National University of Singapore.

¹ Completely autonomous vessels are expected to be in operation in domestic waters as soon as 2020. See Jason Jiang, 'Yara and Kongsberg to build autonomous and zero emissions feeder boxship' (Splash 247, 10

enough to accommodate technological developments, from sail to steam to containerisation, but has evolved over centuries assuming the presence of an onboard crew. This assumption creates some peculiar issues for a crewless ship.²

This article, without assessing the desirability of such ships, considers the legal position for a completely unmanned ship³ and whether such a ship can provide the functional equivalents of a crew, master, and pilot that will allow an autonomous ship to comply with existing international and domestic maritime laws. In order to determine what criteria the autonomous ship will need in order to comply, the article considers where the law demands a human presence on-board a ship. In particular, the article considers how the autonomous ship can comply with seaworthiness obligations, safe manning levels, the duties of the shipmaster, and compulsory pilotage.

2 The proposed ships

There are a number of research projects, both completed and on-going, concerning civilian autonomous ships.⁴ These projects envisage purpose-built ships⁵ that will transport goods

May 2017) <<http://splash247.com/yara-kongsberg-build-autonomous-zero-emissions-feeder-boxship/>> accessed 22 May 2017.

² It is widely accepted that the proposed autonomous vessels will come within the various legal definitions of a 'ship'. See, for example, Professor Dr Eric Van Hooydonk, 'The law of unmanned merchant shipping – an exploration' (2014) 20 *Journal of International Maritime Law* 403; Robert Veal and Michael Tsimplis, 'The integration of unmanned ships into the lex maritima' (2017) 2 *Lloyd's Maritime and Commercial Law Quarterly* 303. If autonomous vessels are not ships, they will require an entirely new maritime legal regime.

³ The current expectations are that the manning of ships will be reduced to one or two seafarers on board before completely unmanned ships enter into operation. This massive reduction in crewing raises other legal issues such as compliance with the Maritime Labour Convention 2006, as well as broader welfare considerations for those seafarers, in particular the effect of isolation on seafarers' mental health.

⁴ For information about each project see DNV-GL, 'Re-Volt – next generation short sea shipping' <<https://www.dnvgl.com/news/revolt-next-generation-short-sea-shipping-7279>> accessed 22 May 2017; Maritime Unmanned Navigation through Intelligence in Networks (MUNIN) <<http://www.unmanned-ship.org/munin/project-result-summary-munin-final-brochure-released/>> accessed 22 May 2017; Advanced Autonomous Waterborne Applications Initiative (AAWA) <<https://www.utu.fi/en/units/law/research/research-projects/Pages/aawa.aspx>> accessed 22 May 2017; Unmanned Multifunctional Maritime Ships Research and Development <<http://en.msa.gov.cn/index.php?m=content&c=index&a=show&catid=336&id=165>> accessed 22 May 2017; MI News Network, 'NAVTOR Takes Maritime Lead For EU Unmanned Vessel Project' (Marine Insight, 19 September 2016) <<http://www.marineinsight.com/shipping-news/navtor-takes-maritime-lead-eu-unmanned-vessel-project/>> accessed 22 May 2017.

⁵ Current models envisage dry bulk carriers and container ships. At this point the dangers of carrying hazardous cargo such as oil, gas, or chemical products are deemed to be too high. See NSSLGlobal White

domestically and internationally without anyone on board. The lack of human presence means that many of the features of a ship layout are removed. There will be no accommodation or deckhouse, which will save on cost, weight and space, thereby increasing cargo-carrying capacity.⁶ Instead of an on-board crew, the ship will be monitored and, occasionally, controlled by operators⁷ on land in a shore control centre. The current joint industry-academia research project on autonomous ships, the Advanced Autonomous Waterborne Applications Initiative (AAWA) anticipates that the behaviour of the ship will follow a dynamic autonomy, meaning that in open seas the ship is likely to be fully autonomous, whereas during other parts of the voyage the ship will need to be more closely monitored or remotely controlled by a shore-based operator (SBO).⁸ The proponents of the autonomous ship scheme envisage that the SBO will provide the functional equivalent for the role of the master and chief engineer.⁹ In the longer term it is possible that the ship will become self-learning and operated by artificial intelligence, removing the human element altogether.¹⁰

Paper, Autonomous/Drone shipping – Economics, timing and communications considerations, available at <<http://www.nsslglobal.com/droneshipping?=twitter>> accessed 22 May 2017.

⁶ Advanced Autonomous Waterborne Applications Initiative (AAWA) Remote and Autonomous Ship – The Next Steps <<https://www.utu.fi/en/units/law/research/research-projects/Pages/aawa.aspx>> accessed 22 May 2017.

⁷ In this context ‘operator’ means the person who is responsible for remotely controlling the movements of the autonomous ship and should not be confused with the ‘operator’ as shipowner or bareboat charterer. See the Merchant Shipping Act 1995 (UK) s 186(5) which provides: In this section ‘owner’, in relation to a ship, includes any part owner and any charterer, manager or operator of the ship.

⁸ Advanced Autonomous Waterborne Applications Initiative (AAWA) Remote and Autonomous Ship – The Next Steps, 7 <<https://www.utu.fi/en/units/law/research/research-projects/Pages/aawa.aspx>> accessed 22 May 2017.

⁹ Maritime Unmanned Navigation through Intelligence in Networks (MUNIN) Deliverable 7.2: Legal and Liability Analysis for Remote Controlled Vessels, 19.

¹⁰ ‘...as the control algorithms will evolve and mature over time, the ships will be capable of handling increasingly complex situations on their own’, Advanced Autonomous Waterborne Applications Initiative (AAWA) Remote and Autonomous Ship – The Next Steps, 11. See also, MUNIN ‘Research in Maritime Autonomous Systems Project Results and Technology Potentials’ <<http://www.cml.fraunhofer.de/content/dam/cml/de/documents/Sonstiges/MUNIN%20-%20final%20brochure.pdf>> accessed 22 May 2017.

3 Manning Levels and Seaworthiness

The biggest hurdle to compliance with the regulatory regimes and seaworthy obligations is the lack of any human physical presence on the ship.¹¹ Safe manning levels are required by a broad range of international and domestic instruments not only for safety at sea but also to determine if a ship is seaworthy.¹² This is crucial in the following contexts:

Unseaworthiness exposes shipowners to cargo claims. A shipowner may not benefit from the exclusions in the Hague and Hague-Visby Rules¹³ from liability for cargo damage if they do not exercise due diligence to make their ship seaworthy before and at the beginning of a voyage.

Unseaworthiness can also void a marine insurance policy.¹⁴ The Marine Insurance Act 1906 (UK) provides that in a voyage policy there is an implied warranty of seaworthiness;¹⁵ while in a time policy, if the ship is sent to sea in an unseaworthy condition with the privity of the assured, the insurer is not liable for any loss attributable to unseaworthiness.¹⁶

For a ship to be seaworthy it must be properly manned.¹⁷ In *Hong Kong Fir Shipping Co v Kawasaki Kisen Kaisah*¹⁸ the court confirmed that an insufficient and incompetent crew can cause a vessel to be unseaworthy.¹⁹ Therefore, the mere fact that there are no crew on board

¹¹ It is a breach of a shipowner's seaworthiness obligation if relevant documents are not carried on board. See discussion by Stephen Girvin, *Carriage of Goods by Sea* (Oxford University Press, 2nd ed, 2011) 388, but this is likely to be obviated as e-certificates are introduced throughout the wider industry. In April 2017, Singapore, Denmark and Norway signed a memorandum of understanding to promote the adoption of E-Certs on vessels registered under their respective flags, recognise E-Cert documents for port entry and port state control inspections, and exchange information and experiences on the issuance, use and industry's reaction to E-Certs. See: Wei Zhe Tan, 'Denmark, Norway and Singapore port authorities ink pact on E-Certificates' (Lloyd's List, 25 April 2017) <<https://www.lloydlist.com/ll/sector/regulation/article554398.ece>> accessed 22 May 2017.

¹² In particular attention is paid to the United Nations Convention on the Law of the Sea (UNCLOS); Safety of Life at Sea Convention (SOLAS); Standards of Training, Certification and Watchkeeping Convention (STCW), COLREGs and the domestic legislation in the UK that gives effect to these international instruments.

¹³ The International Convention for the Unification of Certain Rules of Law Relating to Bills of Lading signed at Brussels on August 25, 1924 as amended by the Protocol signed at Brussels on 23 February, 1968 and by the Protocol signed at Brussels on December 21, 1979.

¹⁴ Marine Insurance Act 1906 (UK), s 39. Implied warranty of seaworthiness.

¹⁵ Marine Insurance Act 1906 (UK), s 39(1).

¹⁶ Marine Insurance Act 1906 (UK), s 39(5).

¹⁷ Article III (1)(b) Hague-Visby Rules requires the carrier to 'properly man, equip and supply the ship' at the beginning of the voyage. Seaworthiness has the same meaning in both contracts for carriage of goods and insurance: *Firemen's Fund Insurance Co v Western Australian Insurance Co Ltd and Atlantic Insurance Co Ltd* (1927) 138 LT 108.

¹⁸ *Hong Kong Fir Shipping Co v Kawasaki Kisen Kaisah* [1962] 2 WLR 474.

¹⁹ *Hong Kong Fir Shipping Co v Kawasaki Kisen Kaisah* [1962] 2 WLR 474, 481.

could render the ship unseaworthy. However, in the *Hong Kong Fir Shipping Co* case, Sellers LJ said that if the crew had been efficient and competent the ship may have been seaworthy notwithstanding the 'numerical deficiency'.²⁰ The competence of the crew rather than the number of crew determines if a ship is seaworthy. Applying this reasoning, provided the SBOs are competent to ensure the safe navigation of the ship, a ship's safe manning level, at common law, could theoretically be zero.

Crew negligence alone does not render a ship unseaworthy²¹ but a failure to provide a proper management system will do so.²² The ISM Code²³ was integrated into SOLAS in 1994²⁴ and requires that shipowners adopt a safety management system. Section 4 provides:²⁵

To ensure the safe operation of each ship and to provide a link between the Company and those on board, every Company, as appropriate, should designate a person or persons ashore having direct access to the highest level of management. The responsibility and authority of the designated person or persons should include monitoring the safety and pollution-prevention aspects of the operation of each ship and ensuring that adequate resources and shore-based support are applied, as required.

The inclusion of this section ensures that ship-owning companies are held responsible for the safety management systems on their vessels. This can be traced, in part at least, to the outcome of the formal investigation into the *MV Herald of Free Enterprise* disaster.²⁶ The court found that the owners partly caused or contributed to the capsizing of the Roll on/Roll off passenger and freight carrier by failing to give clear orders about the duties of the officers

²⁰ *Hong Kong Fir Shipping Co v Kawasaki Kisen Kaisah* [1962] 2 WLR 474, 481.

²¹ *Steel v State Line Steamship Co* (1877) 3 App Cas 72 HL.

²² *Papera Traders Co Ltd v Hyundai Merchant Co Ltd The 'Eurasian Dream'* [2002] 1 Lloyd's Law Reports 719.

²³ International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code), IMO adopted on 4 November 1993 resolution A.741(18).

²⁴ For a brief background into the development of the ISM and its subsequent integration into SOLAS, see Philip Anderson, *ISM code: a practical guide to the legal and insurance implications*, Lloyd's practical shipping guides (2015) 3rd ed Informa.

²⁵ International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code), IMO adopted on 4 November 1993 resolution A.741(18) s 4.

²⁶ *MV Herald of Free Enterprise*, Report of Court No 8074 Formal Investigation September 1987.

serving on-board.²⁷ In this respect, autonomous shipowners may find it easier to comply with this requirement than shipowners of manned ships. As all officers will be in the shore-control centre there is less risk of miscommunication or confusion, consequently the shipowner will have greater control of the operations of the ship.

Incompetence and negligence are not the same.²⁸ The Hague-Visby rules provide the shipowner with a defence for losses caused by a negligent act or omission relating to the navigation or management of the ship.²⁹ This is commonly referred to as the 'nautical fault exception.'³⁰ Therefore, if the SBO is negligent, the shipowner will escape liability, assuming that courts read Article 4 r 2(a) purposively which is questionable, given the current distaste for this particular defence.³¹ However, if the SBO is incompetent, the ship is unseaworthy and the shipowner will be liable. In *The Makedonia*³² the ship suffered a breakdown mid-voyage. Despite exercising due diligence, the shipowners were in breach of the Hague-Visby Rules' seaworthiness condition because at the commencement of the voyage the ship's engineers were inefficient.

How the SBOs will be deemed competent is not yet clear. The AAWA project expects that SBOs will be master mariners with years of seagoing experience.³³ Assuming the standard of competence for an SBO is that of a master mariner, the standard will become increasingly difficult to meet. As more ships become automated, fewer people will be going to sea and therefore the pool of people with requisite skills will shrink. It may be that simulator hours will satisfy the competency level but this is something that will need ongoing consideration by the IMO.

²⁷ See the comments of Sheen J, *MV Herald of Free Enterprise*, Report of Court No. 8074 Formal Investigation September 1987, 14-15.

²⁸ For an analysis of incompetence as against negligence see Roger White, 'The human factor in unseaworthiness claims' [1995] *Lloyd's Maritime and Commercial Law Quarterly* 221.

²⁹ Hague-Visby Rules Art IV r 2(a).

³⁰ Stephen Girvin, *Carriage of Goods by Sea* (Oxford University Press, 2nd ed, 2011) 469.

³¹ See Paul Myburgh, 'Carriers 2 Common Sense 0' (2010) 4 *Lloyd's Maritime and Commercial Law Quarterly* 569.

³² *The Makedonia* [1962] 1 *Lloyd's Rep* 316.

³³ Advanced Autonomous Waterborne Applications Initiative (AAWA) Remote and Autonomous Ship – The Next Steps, 70 <<https://www.utu.fi/en/units/law/research/research-projects/Pages/aawa.aspx>> accessed 22 May 2017.

The 'nautical fault exception' does not extend to any negligent acts or omissions in caring for cargo.³⁴ Article III r 2 of the Hague-Visby rules requires that 'the carrier shall properly and carefully load, handle, stow, carry, keep, care for, and discharge the goods carried'. A shipowner will have 'properly' cared for cargo if they have done so in accordance with a 'sound system'.³⁵ In *Volcafe Ltd v Compania Sud Americana de Vapores SA*³⁶ Flaux J (King and Gloster JJ agreeing) said that '[i]t is well established that one of the indicia of a sound system is that it is in accordance with general industry practice'.³⁷ Although the autonomous ship will be monitored, in the event that something goes wrong with the cargo, for example a refrigerated container loses power, there will be no-one on board to effect a remedy in line with current general industry practice. However, the cargo interests ought to be aware of this before contracting with the carrier and the insurance premium will reflect the risk.³⁸

The Hague-Visby Rules require that a ship is seaworthy at the beginning of the voyage whereas the seaworthiness obligation is ongoing both under a time charter³⁹ and the Rotterdam Rules.⁴⁰ At the commencement of the voyage it is envisaged that the SBO will be closely monitoring the ship as it leaves port, but once the ship is on the high seas it will have a much higher level of autonomy. It is not clear if the autonomous ship will be considered seaworthy at this point as human control will be substantially reduced although it will continue to be monitored. The likelihood is that the ship will only be unseaworthy if something goes wrong that requires a human presence to rectify, such as jettisoning dangerous cargo.

The United Nations Convention on the Law of the Sea (UNCLOS) requires that a flag state must take steps to ensure safety at sea, including measures to ensure that a ship flying its flag has a crew that is appropriate in numbers and qualifications.⁴¹ The Safety of Life at Sea

³⁴ *Gosse Millard Ltd v Canadian Government Merchant Marine Ltd* [1929] AC 223.

³⁵ *The Albacora* [1966] 2 Lloyd's Report 53, 58.

³⁶ *Volcafe Ltd v Compania Sud Americana de Vapores SA* [2016] EWCA Civ 1103.

³⁷ *Volcafe Ltd v Compania Sud Americana de Vapores SA* [2016] EWCA Civ 1103, [72].

³⁸ Provided the assured discloses all relevant information as to the characteristics of the vessel: *Burges v Wickham* 122 ER 251; (1863) 3 B & S 669.

³⁹ *The Laconian Confidence* [1997] 1 Lloyd's Rep 139.

⁴⁰ Rotterdam Rules, art 17 (5)(a).

⁴¹ United Nations Convention on the Law of the Sea, opened for signature 10 December 1982 UNTS 1833 (entered into force 16 November 1994) art 94, 4(b).

Convention (SOLAS) requires that a ship must be ‘sufficiently and efficiently manned’.⁴² Neither Convention, however, provides specific or prescriptive guidance as to what constitutes an appropriate number.

A safe manning level is therefore subjective,⁴³ and jurisdictions have a discretion as to the adequate numbers. For example, in the United Kingdom an owner of a ship submits to the Secretary of State its proposal for safe manning numbers according to the type of vessel and nature of the voyage.⁴⁴ Therefore, the owner of an autonomous ship may submit that a safe manning number is zero. This contrasts with the Singapore position, where the regulations specify the minimum number of crew according to the type of vessel.⁴⁵

The International Convention on Standards of Training Certification and Watchkeeping (STCW Convention) applies to seafarers serving *on board* sea-going ships.⁴⁶ The STCW Convention will therefore not prima facie apply to an autonomous ship. However, given the purpose of the Convention is to promote safety of life and property at sea and the protection of the marine environment, it is foreseeable that the Convention will be expanded to apply to shore-based personnel. Although there will be no crew on an autonomous ship, there will be cargo (property) and the marine environment will be affected by any accident or collision involving an autonomous ship therefore the SBO ought to be considered within the scope of at least the general obligations of the Convention. Further, the STCW Convention expressly allows an administration to adopt other educational and training arrangements adapted for technical developments and to special types of ships and trades, thereby future-proofing the STCW Convention.⁴⁷

Assuming that it is desirable to expand the STCW Convention to include autonomous ships, the skills and standards of competence required of the SBO to ensure safety of life and

⁴² International Convention on the Safety of Life at Sea, opened for signature 1 November 1974 (entered into force 30 June 1980) Chapter V, Safety of Navigation, reg 13.

⁴³ *Hong Kong Fir Shipping Co v Kawasaki Kisen Kaisah* [1962] 2 WLR 474

⁴⁴ Merchant Shipping (Standards of Training, Certification and Watchkeeping) Regulations 2015 (UK) 782, reg 46. applies to seafarers working ‘on-board’ sea going ships so, prima facie, this convention will not apply to autonomous ships.

⁴⁵ Merchant Shipping (Training, Certification and Manning) Regulations 1998 (Singapore), regs 13-14.

⁴⁶ The 1978 International Convention on Standards of Training, Certification and Watchkeeping, art III.

⁴⁷ 1978 International Convention on Standards of Safety Training, Certification and Watchkeeping for Seafarers, as amended by the 2010 Manila Amendments to the Annex, art IX.

property at sea, will not be identical to the skills and competence required by a crew on a manned ship. Therefore, it is perhaps logical to extend its coverage by creating a sister convention that caters to the crewless nature of autonomous ships. This would be akin to how the STCW Convention deals with fishing vessels. The STCW Convention, like others,⁴⁸ exempts fishing vessels from its scope. Instead, fishing vessels have specific convention, namely the STCW-F Convention 2007 that is tailored to the specific nature of those vessels.

While there has been almost universal adoption of the STCW Convention⁴⁹ the domestic laws giving effect to the Convention are not uniform. This creates some issues for autonomous ships.

In the UK, the Merchant Shipping (Standards of Training, Certification and Watchkeeping) Regulations 2015 (UK) 782 give effect to the STCW Convention. Each regulation applies either to seafarers or to ships according to the purpose of the particular regulation.

Part 2 of the regulations, concerned with training and certification, applies to a seafarer serving on board a sea-going ship registered in the United Kingdom.⁵⁰ “Seafarer” means any person, including a master, who is employed or engaged or works in any capacity on board a ship and whose normal place of work is on a ship.⁵¹ Therefore Part 2 of the regulations, in their current form, will not apply to the SBO.

Part 4 of the regulations, which are concerned with safe manning and watchkeeping, apply to sea-going ships which are— (a) United Kingdom ships wherever they are; and (b) other ships when in United Kingdom waters.⁵² Autonomous ships are not exempted from its scope⁵³ but

⁴⁸ MLC, 2006.

⁴⁹ To date over 160 states have ratified the STCW Convention covering over 99% of world tonnage. See <<http://www.imo.org/en/About/Conventions/StatusOfConventions/Documents/Status%20of%20Treaties.pdf>> accessed 22 May 2017.

⁵⁰ Merchant Shipping (Standards of Training, Certification and Watchkeeping) Regulations 2015 (UK) 782, r 4.

⁵¹ Merchant Shipping (Standards of Training, Certification and Watchkeeping) Regulations 2015 (UK) 782, r 3.

⁵² Merchant Shipping (Standards of Training, Certification and Watchkeeping) Regulations 2015 (UK) 782, r 45.

⁵³ The regulations do not apply to: (a) a fishing vessel; (b) a pleasure vessel; or (c) a vessel referred to in regulation 5(3) of the Merchant Shipping (Vessels in Commercial Use for Sport or Pleasure) Regulations 1998, Merchant Shipping (Standards of Training, Certification and Watchkeeping) Regulations 2015 (UK) 782, r 45(2).

as noted above, in the UK, the minimum manning levels are discretionary and will not cause a major legal hurdle to the use of autonomous ships in UK waters.

By contrast, in Singapore, the regulations that give effect to the STCW Convention apply to 'all self-propelled ships registered in Singapore'.⁵⁴ Therefore, those regulations will apply to any autonomous ship registered in Singapore. As the regulations prescribe the minimum number of crew to be carried 'on a ship'⁵⁵ the autonomous ship cannot comply without amendment to the regulations to either exempt the ship from the scope of the regulations or create a new class of ship whose minimum number of crew on board is zero.

This divergence between subjective and prescriptive requirements in relation to manning levels is found in other common law jurisdictions. Australia,⁵⁶ Canada,⁵⁷ Hong Kong,⁵⁸ and Bermuda⁵⁹ all take a subjective approach allowing the authorities discretion when determining manning levels. Therefore, the law in these countries may accommodate crewless ships. Whereas, the United States,⁶⁰ New Zealand⁶¹ and South Africa⁶² all have prescribed numbers and qualifications of personnel required on-board a ship thus placing a significant hurdle before the legal operation of autonomous ships.

4 Compliance with COLREGS

The lack of a crew on board creates another problem when it comes to the 'rules of the road'. The International Regulations for Preventing Collisions at Sea 1972 (COLREGs) apply to all seagoing 'vessels'⁶³ that are used or capable of being used as a means of transportation on water.⁶⁴ Therefore, the autonomous ship, used for transporting cargo on seagoing voyages,

⁵⁴ Merchant Shipping (Training, Certification and Manning) Regulations 1998 (Singapore), reg 3(1).

⁵⁵ Merchant Shipping (Training, Certification and Manning) Regulations 1998 (Singapore), regs 13-14.

⁵⁶ Navigation Act 2012 (Cth) s 51(1).

⁵⁷ Marine Personnel Regulations (SOR/2007-115) reg 202(1).

⁵⁸ Merchant Shipping (Safety) (Ship's Manning) Regulation (Cap. 369 section 107) 1992, r 3.

⁵⁹ Merchant Shipping (Manning of Ships) Regulations 2011, r 5.

⁶⁰ 46 US Code § 8301 - Minimum number of licensed individuals.

⁶¹ Maritime Rules Part 31A: Crewing and Watchkeeping Unlimited Offshore and Coastal (Non-Fishing Vessels) r 7.

⁶² Merchant Shipping (Safe Manning) Regulations 1999, reg 11.

⁶³ International Regulations for Preventing Collisions at Sea, 1972 (hereinafter COLREGS) r 1(a).

⁶⁴ Ibid r 3(a).

will be bound to comply with COLREGs.⁶⁵ Each rule refers directly to the vessel itself rather than an individual, although rule 2(a) places the responsibility to comply with the rules on the vessel, owner, master or crew.⁶⁶ The use of the disjunctive ‘or’ arguably allows responsibility to be placed solely upon the vessel although the COLREGs assume that a vessel has a human presence and this presents a particular difficulty for the autonomous ship.

Specifically, rule 5 places a positive duty on the vessel to maintain ‘a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances’. Sight and hearing means that a person must be physically present on the ship and tasked with the job of maintaining a lookout, forward if possible.⁶⁷ For a remotely monitored ship it may be that the SBO satisfies this requirement if the information is fed back to them by audio-visual methods⁶⁸ and indeed the case law has developed with an emphasis on the ‘available means appropriate’ such as the use of radar.⁶⁹ In this regard, the autonomous ship, which will be equipped with multiple sensors in order to ensure the information on the ship’s surroundings is sufficiently accurate,⁷⁰ has superior ‘available means’ than a manned ship. Nonetheless, this increasing relevance of proper use of technology has not diminished the requirement for a physical lookout. ‘Proper lookout’ is not a limited requirement whereby one available means can displace the use of another. The text of the COLREGs makes it plain that *all* available means ought to be used *as well as* keeping a lookout by sight and hearing.

If the requirement to keep a proper lookout by sight and hearing means that a person must be physically stationed on board the ship, in the event of a collision, the owner and SBOs could find themselves criminally liable for failing to obey the COLREGs. For example,

⁶⁵ Ibid r 3(a) ‘vessel’ includes every description of water craft, including non-displacement craft, WIG craft and seaplanes, used or capable of being used as a means of transportation on water.

⁶⁶ Ibid r 2(a) Nothing in these Rules shall exonerate any vessel, or the owner, master or crew thereof, from the consequences of any neglect to comply with these Rules...or by the special circumstances of the case.

⁶⁷ *The Dea Mazzella* [1958] 1 Lloyd’s Rep 10.

⁶⁸ Robert Veal, ‘Unmanned ships and their international regulation’ (2016) November 18, Shipping and Trade Law.

⁶⁹ *The Anneliese* [1970] 2 All ER 29; [1970] 1 Lloyd’s Rep 355, CA failure to make proper use of radar; *The Maritime Harmony* [1982] 2 Lloyd’s Rep 400, maintaining poor radar lookout; *The Nordic Ferry* [1991] 2 Lloyd’s Rep 591, Master failing to keep a proper watch of radar; *The Maloja II* [1993] 1 LR 48, failure to keep a careful radar lookout.

⁷⁰ Advanced Autonomous Waterborne Applications Initiative (AAWA) Remote and Autonomous Ship – The Next Steps, 16 <<https://www.utu.fi/en/units/law/research/research-projects/Pages/aawa.aspx>> accessed 22 May 2017.

regulation 6 of the Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996 (UK),⁷¹ which gives effect to the COLREGs, provide:

- (1) Where any of these Regulations is contravened, the owner of the vessel, the master and any person for the time being responsible for the conduct of the vessel shall each be guilty of an offence punishable on conviction on indictment by imprisonment for a term not exceeding two years and a fine, or on summary conviction by a fine:

Determining who is responsible for the conduct of an autonomous ship 'for the time being' is going to be complex. The AAWA project anticipates the behaviour of the ship will follow a dynamic autonomy, meaning that in open seas the ship is likely to be fully autonomous, whereas during some parts of the voyage the ship will need to be closely monitored or remotely controlled.⁷² SBOs will be responsible if they are driving the ship by remote control but if artificial intelligence is driving and making the navigational decisions of the ship, ought the SBOs to be deemed responsible for the ship's conduct rather than the producer of the autonomous navigation technology? Such technology generates decisions that are difficult for humans to understand as it learns patterns from data and builds a model of the process involved.⁷³ While the producer of the technology may understand the artificial intelligence decision-making process,⁷⁴ the SBO may not. Although it is anticipated that a human will monitor the autonomous ship, if the artificial intelligence makes a decision that breaches COLREGs, ought the human that created the technology to be responsible 'for the time being'? In any event, the owner of the autonomous ship will be held liable, as will the SBO should he or she be deemed to be the 'master' of the autonomous vessel.

A breach of the COLREGs alone does not mean that liability arises unless it is established that the breach of the COLREGs is negligent.⁷⁵ However, this does not mean that in the absence of

⁷¹ Merchant Shipping (Distress Signals and Prevention of Collisions) Regulations 1996, r 6

⁷² Advanced Autonomous Waterborne Applications Initiative (AAWA) Remote and Autonomous Ship – The Next Steps, 7 <<https://www.utu.fi/en/units/law/research/research-projects/Pages/aawa.aspx>> accessed 22 May 2017.

⁷³ Chris Reed, Elizabeth Kennedy and Sara Nogueira Sliva, 'Responsibility, Autonomy and Accountability: legal liability for machine learning' Queen Mary University of London, School of Law, Legal Studies Research Paper No 243/2016, 4.

⁷⁴ Chris Reed, Elizabeth Kennedy and Sara Nogueira Sliva, 'Responsibility, Autonomy and Accountability: legal liability for machine learning' Queen Mary University of London, School of Law, Legal Studies Research Paper No 243/2016, 4.

⁷⁵ Simon Gault et al (eds) *Marsden and Gault, Collisions at Sea* (Sweet and Maxwell, 14th ed, 2016) 89.

negligence, the autonomous ship is excused from complying with the rules.⁷⁶ Convenience and inability to comply, unless there are special circumstances,⁷⁷ are not valid reasons for departure from the COLREGs.⁷⁸ However, departure from the COLREGs may be required where strict adherence to the rules would create a dangerous situation.⁷⁹ The development of an obstacle detection and avoidance system of an autonomous ship cannot 'blindly implement the COLREGs'⁸⁰ and will need to reflect the intuition, common sense and experience of a skilled mariner.⁸¹ While SBOs are expected to monitor the navigation of the autonomous ship, the artificial intelligence that makes the navigational decisions is not within their control. If the artificial intelligence of the autonomous ship makes a navigational decision that complies strictly with COLREGs but creates a more dangerous situation, ought the SBO be held responsible or ought that liability rest with the creator of the artificial intelligence? The reaction time of a human will be slower than an autonomous system and by the time the SBO realises there is a danger it may be too late to intervene.⁸² Nonetheless the objective standard, to which the artificial intelligence is held, must be at least equivalent to an experienced shipboard master. If the artificial intelligence makes rash decisions that an experienced shipboard master would not have made this, prima facie, constitutes negligence. One proposed solution to this issue is to use the COLREGs hierarchy of responsibility between vessels and define the autonomous ship as 'not under command'.⁸³ thereby requiring that all

⁷⁶ For more on the technical development of an automatic collision avoidance technique based upon COLREGs see Wasif Naeem, George W Irwin, Aolei Yang, 'COLREGs-based collision avoidance strategies for unmanned surface vehicles' (2012) 22 *Mechatronics* 669.

⁷⁷ Inability to comply is where the conditions are such that it is more dangerous to comply rather than meaning the build or structure of the vessel renders it unable.

⁷⁸ Simon Gault et al (eds) *Marsden and Gault, Collisions at Sea* (Sweet and Maxwell, 14th ed, 2016) 167.

⁷⁹ COLREGS, r 2(b).

⁸⁰ Sable Campbell, Mamun Abu-Tair and Wasif Naeem, 'An Automatic COLREGs-complaint obstacle avoidance system for an unmanned surface vehicle', (2014) 228(2) *Journal of Engineering for the Maritime Environment* 108, 110.

⁸¹ Sable Campbell, Mamun Abu-Tair and Wasif Naeem, 'An Automatic COLREGs-complaint obstacle avoidance system for an unmanned surface vehicle', (2014) 228(2) *Journal of Engineering for the Maritime Environment* 108, 110.

⁸² This is analogous to accidents involving self-driving cars. See Mark Bergen, 'Police Report on Uber Self-Driving Car Crash Tells Complex Tale' *Insurance Journal* 30 March 2017 <<http://www.insurancejournal.com/news/national/2017/03/30/446094.htm>> accessed 22 May 2017.

⁸³ COLREGs r 3. A power-driven vessel must give way to all other vessels (except a seaplane); sailing vessel must give way to a vessel not under command, a vessel restricted in her ability to manoeuvre and a vessel engaged in fishing; a vessel engaged in fishing gives way to vessel not under command and a vessel restricted in her ability to manoeuvre.

other vessels must keep out of her way. Gogarty and Hagger submit that an autonomous ship will have a 'navigable right of way'⁸⁴ as it is questionable if she is 'under command' in circumstances where one SBO is monitoring a number of autonomous ships simultaneously.

However, the courts have interpreted the words 'not under command' as referring to a ship that has, exceptionally, lost her ability to be controlled through some failure of equipment or damage rather than the absence of a crew as a normal or routine feature of the ship itself. In the *Mendip Range v Radcliffe*,⁸⁵ a naval vessel collided with a merchant ship. The naval vessel had been torpedoed and was exhibiting two black shapes to show that she was not under command. In finding that the naval vessel was not negligent, Viscount Finlay explained:⁸⁶

If a vessel is in such a condition owing to an accident that she can only get out of the way of another after great and unusual delay, I think she must be considered as 'not under command'. She is not able to behave as those on board other vessels meeting her would reasonably expect.

How other ships will 'reasonably expect' an autonomous ship to behave will become clearer once sea-trials are undertaken and autonomous ships become operational but at minimum she ought to follow COLREGs and be able to keep out of the way of other ships without great or unusual delay.⁸⁷ So long as the autonomous ship has the ability to navigate, whether or not with the input of an SBO, she will be deemed to be under command for purposes of the COLREGs.⁸⁸ However, in the event that communications are lost between the shore control centre and the ship, she may become 'not under command' if it is essential that a human must have the ability to take control or she is unable to manoeuvre safely. The ship will need to have the ability to exhibit this to other vessels.

Alternatively, Gogarty and Hagger submit that the autonomous ship could be deemed restricted in her ability to manoeuvre, meaning that all other vessels, except for those not

⁸⁴ Brendan Gogarty and Meredith Hagger, 'The Laws of Man over Vehicles Unmanned: The Legal Response to Robotic Revolution on Sea, Land and Air' (2008) 19 *Journal of Law, Information and Science* 73, 115.

⁸⁵ *Mendip Range v Radcliffe* [1921] 1 AC 556.

⁸⁶ *Mendip Range v Radcliffe* [1921] 1 AC 556, 571 per Viscount Finlay.

⁸⁷ *The Djerada* [1976] 1 Lloyd's Law Rep 50, 56.

⁸⁸ For a definition of 'under command' see *The Bellanoch* [1907] P 170 at 174, CA, per Gorell Barnes P: 'This vessel, according to the view the Elder Brethren take, was under command; she was moving, and capable of doing what she wanted to do'.

under command, will be required to keep out of her way. Whether she is restricted in her ability to manoeuvre will be dependent on the level of autonomy of the ship and the type of work in which she is engaged.⁸⁹ This is a valid argument if the autonomous ship is engaged in activities of the nature of one of the categories listed in rule 3(g). This rule provides a limited range of ship operations that are classed as restricting a ship's ability to move, such as dredging, launch or recovery of aircraft, mine clearance or a towing operation that severely restricts her ability to manoeuvre. If the autonomous ship is engaged in a cargo carrying voyage, this is not work that is covered by rule 3(g). Therefore, the autonomous vessel, as a power-driven vessel, will be given the highest level of responsibility in the COLREGs hierarchy.

Even if the autonomous ship is navigating without human intervention, it is anticipated that there will be humans monitoring her in the shore control centre who ought to be ready to take control in an emergency, provided the communications are operating. These people will be the functional equivalent of a crew. So long as the navigation system operates with at least the equivalent standard of the intuitive skilled mariner, she will be able to comply with the majority of the COLREGs. Nonetheless, the requirement to keep a lookout by sight and hearing remains unresolved.

Law must keep pace with technology. As the COLREGs currently stand, the autonomous ship will not comply. However, this is not an insurmountable issue. The COLREGs can be, and have been, readily updated by the IMO.⁹⁰ Rather than trying to bend the rules to suit autonomous ships, a separate annex to the COLREGs that applies to autonomous ships could be considered. Alternatively, COLREGs could be amended to include autonomous ships within the class of vessels restricted in their ability to manoeuvre. Or, rule 5 could be amended to read: 'Every *manned* vessel shall.... maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances.....', thus relieving the autonomous ship from the lookout by sight and hearing requirement.⁹¹ However, there will

⁸⁹ Brendan Gogarty and Meredith Hagger, 'The Laws of Man over Vehicles Unmanned: The Legal Response to Robotic Revolution on Sea, Land and Air' (2008) 19 *Journal of Law, Information and Science* 73, 115.

⁹⁰ A N Cockcroft and J N F Lameijer, *A Guide to the Collision Avoidance Rules*, 7th edition, Elsevier 2012, 137.

⁹¹ Craig H Allen, 'The Seabots are Coming Here: Should they be treated as vessels?' (2012) 65 *Journal of Navigation* 749, 750-751. These amendments were recommended by the United States Navigation and Safety Advisory Council in 2011.

need to be another set of lookout regulations that apply to autonomous ships or such an amendment will amount to *carte blanche* for autonomous ships.

5 The Master

The AAWA and MUNIN projects both predict that the SBO will take on the role of the master as they will be monitoring the ship and making navigational decisions, at least while the ships are 'remote controlled'.

The legal definitions of a master vary according to jurisdiction. However, Cartner et al submit that all definitions have the following elements:

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.⁹²

In the United Kingdom, "“master” includes every person (except a pilot) having command or charge of a ship’.⁹³ This definition is wide enough to define anyone who is able to control the ship’s movements⁹⁴ or are responsible for the ship’s navigation as a ‘master’. The SBO will be responsible for ensuring that the autonomous ship is navigating safely, that the systems are all functioning correctly and monitoring the cargo. This person fits that definition of master.

However, the customary role of the master is much broader than that. The master has a number of roles that extend beyond the navigation of the ship. The master has legal duties and responsibilities both under the international Conventions, enacted through the domestic laws of the flag state of the ship and the domestic laws of the port states in which the ship berths, as well as in private law. The SBO cannot practically meet all these obligations.

⁹² John A C Cartner, Richard P Fiske, Tara L Leiter, *The International Law of the Shipmaster*, Informa 2009, 86.

⁹³ Merchant Shipping Act 1995 (UK) c 21, s 313.

⁹⁴ For a definition of ‘under command’ see *The Bellanoch* [1907] P 170 at 174, CA, per Gorell Barnes P: ‘This vessel, according to the view the Elder Brethren take, was under command; she was moving, and capable of doing what she wanted to do’.

5.1 Duty to render assistance

UNCLOS, SOLAS and the Salvage Conventions (both 1910 and 1989) place a personal obligation on the master to render assistance to other ships or persons in distress at sea. This is a major issue for an autonomous ship. The shipowner is not vicariously liable for the master's failure to render assistance under the Salvage Conventions,⁹⁵ while both UNCLOS and SOLAS are silent on the liability of shipowners for the failure of the master to rescue. If the SBO is legally the master, they have a personal duty to render assistance and may find themselves criminally liable for any failure to do so.

UNCLOS Article 98 requires:⁹⁶

Every state shall require the master of a ship flying its flag, in so far as he can do so without serious danger to the ship, the crew or the passengers ... to render assistance to any person found at sea in danger of being lost ... and to proceed with all possible speed to the rescue of persons in distress, if informed of their need for assistance, in so far as such action may reasonably be expected of him.

SOLAS provides:⁹⁷

the master of a ship at sea which is in a position to be able to provide assistance, on receiving a signal from any source that persons are in distress at sea, is bound to proceed with all speed to their assistance, if possible informing them or the search and rescue service that the ship is doing so.

The Salvage Conventions provide:⁹⁸

Every master is bound, so far as he can do so without serious danger to his vessel and persons thereon, to render assistance to any person in danger of being lost at sea.

⁹⁵ Salvage Convention 1910, art 11 and Salvage Convention 1989, art 10 (3).

⁹⁶ United Nations Convention on the Law of the Sea, opened for signature 10 December 1982 UNTS 1833 (entered into force 16 November 1994) art 98.

⁹⁷ International Convention on the Safety of Life at Sea, opened for signature 1 November 1974 (entered into force 30 June 1980) Chapter V, Safety of Navigation, reg 10.

⁹⁸ Salvage Convention 1910, art 11; Salvage Convention 1989, art 10 (1).

UNCLOS and the Salvage Conventions qualify the duty by only requiring the master to assist if it will not endanger their ship, passengers or crew. SOLAS is similarly qualified by the words “which is in a position to be able to provide assistance”.⁹⁹ Even if the autonomous ship is in a location that can reach people in need of assistance, the SBO (if deemed to be the master for the purposes of SOLAS) will not be in a position to render assistance beyond alerting other ships or coastal authorities.

The Merchant Shipping Act (UK) imposes a duty on the master to assist aircraft in distress¹⁰⁰ ‘unless he is unable, or in the special circumstances of the case considers it unreasonable or unnecessary, to do so’.¹⁰¹ The master is subject to criminal sanctions for failure to comply.¹⁰² There is no reference to the shipowner. Given that the Merchant Shipping Act places joint and several liability on the master in other sections of the Act,¹⁰³ the legislation does not intend the shipowner to be vicariously liable for the failure of the master to assist. As there is no master on board perhaps the autonomous ship will be relieved of this obligation completely while additionally, the fact that she cannot carry people creates a ‘special circumstance’ that makes it unreasonable to comply.

If the autonomous ship is in a collision with a manned ship, the Merchant Shipping Act UK requires the master to render any such assistance as is ‘practicable’.¹⁰⁴ It is reasonable to argue that is not practicable for the autonomous ship to render physical assistance given that she is not designed to carry people and will not have lifeboats or any necessities on board (such as food, water, or first aid supplies). This should not mean that the autonomous ship can steam on without raising an alarm or call for assistance from a nearby manned ship or the nearest coastal state. At a minimum, the autonomous ship ought to communicate the need for help to third parties.

If the autonomous ship gets into difficulty there is no obligation on coastal states or other vessels to render assistance as there are no lives on board. The obligation on the autonomous

⁹⁹ SOLAS, Chapter V, Safety of Navigation, reg 10.

¹⁰⁰ Merchant Shipping Act 1995 (UK) c 21, s 93 (1).

¹⁰¹ Merchant Shipping Act 1995 (UK) c 21, s 93 (1).

¹⁰² Merchant Shipping Act 1995 (UK) c 21, s 93(6).

¹⁰³ For example s 98 holds both the owner and master criminally liable for a dangerously unsafe ship.

¹⁰⁴ Merchant Shipping Act 1995 (UK) c 21, s 92.

ship to render assistance beyond alerting other manned vessels or the search and rescue authorities of the coastal state is practically unrealistic as is expecting a manned vessel to have any obligation to assist the autonomous ship.¹⁰⁵

Further, the obligation to render assistance is very difficult to enforce.¹⁰⁶ In order for a person who is not rendered assistance to successfully sue a master, they would first have to survive,¹⁰⁷ identify the ship that failed to render assistance, and finally establish the correct jurisdiction over the master or the ship.¹⁰⁸ These hurdles are even higher for the descendants of deceased victims.¹⁰⁹ Jurisdictional issues are also a further barrier for a successful criminal prosecution against a master for failing to render assistance on the high seas especially in circumstances where the person or people requiring help are asylum seekers and refugees. The three jurisdictions that can prosecute are; the flag state of the vessel; or if the master does not share the nationality of the flag state, the country of which the master is a citizen; and the country of which the victim is a citizen. Considering that refugees are fleeing their country, it is highly improbable that their country would pursue a prosecution. How a prosecution would work against an autonomous ship is even more difficult to imagine, particularly if there is no one person that is the master.

There is increasing tension between the duty placed on the master to render assistance and the risk to the master of being charged with people smuggling. In the, now infamous, *Tampa*¹¹⁰ incident, the master of the Norwegian flagged cargo ship, upon the request of Australian authorities, and complying with his legal duty to render assistance, rescued over 400 people from an Indonesian fishing vessel which was sinking near to Christmas Island. The

¹⁰⁵ There is no 'quid pro quo with other sea-users in this respect'. Robert Veal and Michael Tsimplis, 'The integration of unmanned ships into the lex maritima' (2017) 2 Lloyd's Maritime and Commercial Law Quarterly 303, 330.

¹⁰⁶ Martin Davies, 'Obligations and Implications for ships encountering persons in need of assistance at sea' (2003) 12 Pacific Rim Law and Policy Journal 109.

¹⁰⁷ "Dead men tell no tales. Nor do they sue." Patrick Long, 'The Good Samaritan and Admiralty: A parable of a statute lost at sea', (2000) 48 Buffalo Law Review 591, 610.

¹⁰⁸ Martin Davies, 'Obligations and Implications for ships encountering persons in need of assistance at sea' (2003) 12 Pacific Rim Law and Policy Journal 109, 115.

¹⁰⁹ "Dead men tell no tales. Nor do they sue." Patrick Long, 'The Good Samaritan and Admiralty: A parable of a statute lost at sea', (2000) 48 Buffalo Law Review 591, 610.

¹¹⁰ *Victorian Council for Civil Liberties Inc v Minister for Immigration and Multicultural Affairs* (2001) 110 FCR 452.

same authorities told the master that if he entered Australian waters, with the intent of off-loading the rescuees, he would be prosecuted with people smuggling.¹¹¹

More recently, there have been (unsuccessful prosecutions) of masters and seafarers related to the European migrant crisis for assisting irregular entry under aggravated circumstances.¹¹² It appears there have been no prosecutions for failing to render assistance despite commercial vessels failing to assist drifting boatloads of migrants and refugees in the Mediterranean.¹¹³

Nevertheless, the duty to render assistance to persons in distress is a moral obligation¹¹⁴ as well as a legal duty. It is difficult to argue that those who profit financially from the operation of an autonomous ship can be immune from such obligations. It may make the concept of an autonomous ship more palatable to sceptics if the ship is equipped with life-rafts containing first aid kits, food and water that can be jettisoned to render assistance to people at risk until they are rescued. As the ship is unmanned, she may even be able to assist in circumstances that would be too dangerous for a manned ship.

5.2 The master as agent

The master acts as the agent of the shipowner. Further sources of the master's private authority are contained in bills of lading, charterparties and shipper advice.¹¹⁵ The master is the person tasked with accurately noting the condition of cargo at the time of shipment.¹¹⁶ Unless the SBO is to be on the wharf at the time of loading (which is highly unlikely given that

¹¹¹ Donald R Rothwell, 'The Law of the Sea and the MV Tampa Incident: Reconciling Maritime Principles with Coastal State Sovereignty', (2002) 13 Public Law Review 118. Ultimately, the master made the decision to enter Australian territorial seas, following the deterioration in the health of some of the rescuees and concern for the welfare of his crew. Two hours after entering Australia's territorial sea, Australian Special Armed Services troops boarded the *Tampa*. Four days later the rescuees were transferred onto an Australian naval vessel and transferred to Papua New Guinea. The master was not prosecuted.

¹¹² Tugba Basaran, 'The saved and the drowned: Governing indifference in the name of security', (2015) 46(3) Security Dialogue 205, 211.

¹¹³ See, Diane Taylor, 'Refugees stranded for 30 hours before rescue in Mediterranean', *The Guardian* (London, 21 April 2017) <<https://www.theguardian.com/world/2017/apr/21/refugees-stranded-mediterranean-dinghy>> accessed 24 April 2017.

¹¹⁴ *The Valverda* (1937), 59 Lloyd's Law Reports 230, 240.

¹¹⁵ John A C Cartner, Richard P Fiske, Tara L Leiter, *The International Law of the Shipmaster*, Informa 2009, 122.

¹¹⁶ John A C Cartner, Richard P Fiske, Tara L Leiter, *The International Law of the Shipmaster*, Informa 2009, 124.

they may not even be in the same country as the autonomous ship), this is a role that will have to be delegated by the owner or charterer to an agent in the relevant port. It is not anticipated that the SBO will act as the shipowner's agent for the purposes of dealing with cargo as opposed to ship management and navigation. There is no reason to expect that the SBO will have the authority to enter contracts that bind the owner.

The master has the right to refuse to load dangerous cargo.¹¹⁷ While this is a right that can be delegated to a port agent of the shipowner, they may not have the same diligence and concern about dangerous cargo. After all, if a master puts to sea with dangerous cargo they risk not only the safety of the ship and crew but their own life as well. The master must use their expertise to inspect cargo (to the objective standard of a reasonably careful master¹¹⁸) and has a duty to clause a bill of lading if the goods are defective.¹¹⁹ A shore-based agent may be more susceptible to pressure to sign clean bills of lading or overlook misdeclared cargo.

The extensive authority placed upon a ship's master stems from customary rules when communication with the shipowner while at sea was impossible and the master's authority to enter contracts on the shipowner's behalf assisted in the commercial development of shipping. With the advent of instantaneous communication and electronic payment systems it is questionable if the ship's master ought to continue to have this same level of authority.

Gold argues that if the ship's operational decisions are being made onshore, the 'legal fiction' of making the shipmaster responsible for almost everything ought to be abandoned.¹²⁰ However, he concedes that this is unlikely because it would 'upset the delicate balance between ship operations, liability and hull insurance, and cargo risks'.¹²¹ The autonomous ship project provides an opportunity for the rights and obligations of the master to be reassessed more generally. The traditional role of the master simply cannot apply to an

¹¹⁷ John A C Cartner, Richard P Fiske, Tara L Leiter, *The International Law of the Shipmaster*, Informa 2009, § 9.4.

¹¹⁸ *The David Agmashenebeli* [2003] 1 Lloyd's Law Reports 92, 105.

¹¹⁹ Stephen Girvin, *Carriage of Goods by Sea* (Oxford University Press, 2nd ed, 2011) 81.

¹²⁰ Edgar Gold, 'From Privilege to Peril – The Shipmaster's Current Legal Rights and Responsibilities' (2004) 3(1) World Maritime University Journal of Maritime Affairs 51, 65.

¹²¹ Edgar Gold, 'From Privilege to Peril – The Shipmaster's Current Legal Rights and Responsibilities' (2004) 3(1) World Maritime University Journal of Maritime Affairs 51, 65.

autonomous ship. The responsibilities and duties traditionally allocated to this role will be distributed between the owner, the SBO, and ship's agent.

The master on board a manned ship has a far greater degree of autonomy to make decisions about the operation of their ship than the SBO. The traditional role of the shipmaster will be consigned to history when autonomous ships enter into operation. The SBO will not have the same level of authority as a master on board a manned ship and it is simply unreasonable to place all the current liabilities of the master onto the SBO.

Although there will be no crew on board an autonomous ship, the responsibilities that currently rest on the shoulders of the shipmaster with respect to bills of lading, cargo inspection, legal documents, dangerous cargo will not disappear. If there is no single person who remains answerable for any mistakes, fraud, or negligence, it is likely that standard expected of the 'reasonably careful master' will slide. Shipowners and authorities will need to remain alert.

6 Pilotage

Pilots have been used to guide ships safely in and out of ports by providing local knowledge for centuries.¹²² A pilot is defined as 'any person not belonging to a ship who has the conduct thereof'.¹²³ However, the master remains in command of their ship even when a pilot has control.¹²⁴ When it comes to entering or leaving a port, the AAWA project envisages that at this point the SBO will either choose to 'take teleoperation type control or increase the supervision level of the vessel'.¹²⁵ However, this assumes port authorities will permit the autonomous ship to berth by remote control. Most ports in the world impose compulsory pilotage areas, and pilotage is also compulsory in some environmentally sensitive waters.¹²⁶

¹²² IMO, 'Pilotage' <<http://www.imo.org/en/OurWork/Safety/Navigation/Pages/Pilotage.aspx>> accessed 23 May 2017.

¹²³ Pilotage Act 1987 (UK) c 21, s 31(1).

¹²⁴ To 'conduct a ship' must not be confused with being 'in command of a ship'. The first expression refers to an action, to a personal service being performed; the second to a power: Canada, Report of the Royal Commission on pilotage, Part 1, 27.

¹²⁵ AAWA, 'Remote and Autonomous Ships – The next steps' (Position Paper, Rolls-Royce plc, 2016), 12.

¹²⁶ For example Marine Order 54 (Australia) requires compulsory pilotage through areas including the Great Barrier Reef and the Torres Strait.

The master plays a crucial role alongside the pilot to navigate their ship safely in such waters and this is going to cause some legal problems for the autonomous ship.

While the details of pilotage law vary from jurisdiction to jurisdiction (and indeed from port to port) there are some legal principles that universally apply. Namely, that the pilot is an advisor for the purpose of navigation, the command of the ship remains with the master and any negligent act of the pilot is deemed to be an act of the ship.¹²⁷ The duty of a licensed pilot is to provide information and advice while on a vessel to the master of the vessel to assist the safe navigation of the vessel in a compulsory pilotage area.¹²⁸ The shipowner is vicariously liable for the negligence of a compulsory pilot as the master is 'bound to permit' the pilot to have control of the ship¹²⁹ and the pilot is deemed to be a servant¹³⁰ of the shipowner while acting within the scope of their authority.¹³¹ A shipowner will be liable for the fault of a pilot regardless of whether or not the pilotage is compulsory.¹³²

The Pilotage Act 1987 (UK) makes it an offence for a master to navigate in an area and in circumstances where pilotage is compulsory.¹³³ This means that the SBO (if deemed the master) could find themselves committing an offence even the ship is navigating autonomously and could be held liable. Even if pilotage is not compulsory, a master can be blamed for not employing a pilot if it can be shown that the failure to do so contributed to an accident.¹³⁴

There are a number of legal issues relating to the pilotage of autonomous ships. First, the common law says that pilotage only commences once the pilot is '*on board* [emphasis added] at a particular place for the purpose of conducting a ship through a river, road or channel or

¹²⁷ See The Standard Club, Pilotage Bulletin, May 2016.

¹²⁸ Marine Order 54 (Cth) r 8(a).

¹²⁹ *The Adoni* [1918] P 14, 18.

¹³⁰ *Esso Petroleum Ltd v Hall, Russell & Co* [1988] 3 WLR 730 (HL).

¹³¹ Christopher Hill opines that the pilot is in fact an agent of the shipowner and therefore the crew must obey them. *Maritime Law: Lloyd's List Practical Guides*, Lloyd's of London Press Ltd 4th ed 1995, 520.

¹³² Prior to 1913, under English law, shipowners could rely on the defence of compulsory pilotage. This defence was abolished by the Pilotage Act 1913 (UK).

¹³³ Pilotage Act 1987 (UK) c 21, s 15 (3).

¹³⁴ R P A Douglas and G K Geen, *The Law of Harbours and Pilotage*, (1993) Lloyd's of London Press 4th ed, 208 citing *The Alletta* [1965] 2 Lloyd's Rep 479.

from or into a port'.¹³⁵ So if the pilot cannot board the ship because she is not designed to carry people, put simply, pilotage cannot take place.

In the *Guy Mannering*, Brett LJ explained the pilot 'is in fact to be a kind of living chart. But a pilot is not to go beyond this: the captain must direct how the ship is to be steered and the whole duty of managing her devolves upon him.'¹³⁶ In the same case Cotton LJ stated: 'the pilot has not the control of the vessel: the captain has the control, and is the person in charge.'¹³⁷ However in a later case, *The Nord*,¹³⁸ Bargrave Deane J said that the word 'conducted' means that the 'pilot is in charge under the old system – that is in full charge.....He is in command'.¹³⁹

By making the words 'conducted' and 'in command' synonymous, Bargrave Deane J appears to support the position held by Dr Lushington in *The Peerless*¹⁴⁰ that it is dangerous to have divided authority when navigating a ship and that the master ought only interfere with the pilot's authority in extraordinary circumstances.

Nonetheless, the master continues to have responsibility for the vessel even when the pilot has control. In the words of Bargrave Deane J, 'he is not entitled to fold his arms and say, "I have no responsibility towards the pilot in charge of my ship."' ¹⁴¹ The pilot therefore does not supersede the master in command of the ship and the master may overrule the pilot.¹⁴² If it is not clear who the master is, then to whom is the pilot answerable?

¹³⁵ *The Adoni* [1918] P 14.

¹³⁶ *The Guy Mannering* [1882] P 132, 135.

¹³⁷ *The Guy Mannering* [1882] P 132, 136.

¹³⁸ *The Nord* [1916] P 53.

¹³⁹ *The Nord* [1916] P 53, 56.

¹⁴⁰ *The Peerless* (1860) 167 ER 16, at 17, There may be occasions on which the master of a ship is justified in interfering with the pilot in charge, but they are very rare. If we encourage such interfering, we should have a double authority on board, a divisum imperium, the parent of all confusion, from which many accidents and much mischief would most surely ensue. If the pilot is intoxicated, or is steering a course to the certain destruction of the vessel, the master no doubt may interfere and ought to interfere, but it is only in urgent cases.

¹⁴¹ *The Tactician* [1907] P 244. The Maritime Code of the People's Republic of China 1993, Article 39, makes the master's responsibility in this regard even more clear, '[t]he presence of a pilot on board shall not discharge the duty of the Master of management and navigation of the ship'

¹⁴² For a useful discussion on the relationship between the master and the pilot see R P A Douglas and G K Geen, *The Law of Harbours and Pilotage*, (1993) Lloyd's of London Press 4th ed, 199-220.

If the autonomous ship is designed to allow a pilot to board, that is another problem. One of the most significant benefits of the autonomous ship is that she is less likely to be at risk of piracy since she will be designed to make it difficult to board and the computer system inaccessible.¹⁴³ If the system can be over-ridden and the ship accommodate people then this benefit is obviated.¹⁴⁴

Furthermore, if the pilot is operating the ship without the master at their shoulder, is the owner still liable for the error of the pilot despite having no representation on-board? Prior to the Pilotage Act 1913 (UK) shipowners could rely on the defence of compulsory pilotage for the negligence of the pilot.¹⁴⁵ This defence was abolished to bring English law into line with Article 5 of the Collision Convention 1910 and the laws of other countries.¹⁴⁶ Prior to its abolition, 'an unending stream of litigants' attempted to attach blame to pilots to avoid paying damages.¹⁴⁷ Reviving this defence is unlikely.¹⁴⁸

The pilot is personally liable to the shipowner for damages caused by their negligence but in most jurisdictions this is limited to an almost insignificant amount.¹⁴⁹ The pilot's employer (be it a public body or private company) is not vicariously liable for their actions. *Oceanic Crest*

¹⁴³ Oskar Levander, Forget Autonomous Cars – autonomous ships are almost here, *IEEE Spectrum*, 28 January 2017 <<http://spectrum.ieee.org/transportation/marine/forget-autonomous-cars-autonomous-ships-are-almost-here>> accessed 22 May 2017.

¹⁴⁴ Similarly, if autonomous ships can accommodate people, these ships may also be at risk of stowaways and potentially expands the scope of the duty to render assistance given that the ship in fact can carry people.

¹⁴⁵ *The Maria* (1839) 1 W Rob 95.

¹⁴⁶ Francis Rose, *The Modern Law of Pilotage* (Sweet and Maxwell, 1984) 38.

¹⁴⁷ R P A Douglas and G K Geen, *The Law of Harbours and Pilotage* (4th ed, Lloyd's of London Press, 1993) 199.

¹⁴⁸ According to the Travaux Préparatoires to the Collision Convention 1910 the defence was ended for the following reasons. First, the use of a compulsory pilot does not increase the risk of collision incurred by the shipowner. Consequently, it should not reduce their responsibility. This remains valid if the autonomous ship is being controlled by a shore based operator who does not have local knowledge of the waters in question. Second, if the liability of the shipowner is reduced, the loss falls on innocent third parties damaged by a collision. Third, if the shipowner's liability is removed, it falls on the pilot who is at constant risk of being financially ruined. If vicarious liability is placed upon the pilot's employer or the port authority, this issue would be resolved. However, as discussed below, this is unlikely to be an option. Fourth, a shipowner is advantaged by a pilotage system that lessens the risk of entering a port but the purpose of the system is not to remove the shipowner's liability. The risk of a failure in skill or care would apply equally if the pilotage was left to the master and crew. In order to protect the shipowner's interests, a master may be tempted to leave matters in the hands of the pilot when he ought to interfere. This is also valid if the shore based operator is able to interfere. If the SBO is unable to interfere, the pilot then has command of the ship and will now be in the role of the master.

¹⁴⁹ The Pilotage Act 1987 (UK) c 21, s 22(1) limits a pilot's liability to £1000.

*Shipping Co v Pilbara Harbour Services Pty Ltd*¹⁵⁰ made clear that the pilot's employer is not vicariously liable for the negligence of the pilot because:¹⁵¹

as far as the pilot's general employer is concerned, the pilot is executing an independent legal duty conferred on him by law and his powers are not derived from the general employer; on the other hand, it may be said that the pilot's power does derive at least in part from the authority given by the shipowner — in that regard it will be remembered that the master has, though only in exceptional circumstances, power to take control of navigation out of the hands of the pilot.

The master is the person who remains responsible for the safety of the ship. If the 'master' is the SBO in another country, communicating with a pilot who may not be familiar with the operation of an autonomous ship, does the master really have command? Does the pilot have control? These concepts do not sit easily with the operation of an autonomous ship.

The issue here is control. A pilot cannot take control of an autonomous ship unless the pilot is either able to instruct the SBO or board the ship and operate it manually. This assumes the pilot has not only local knowledge but also knowledge of how the autonomous ship operates. What happens if communications are lost? Who is liable for any loss that is incurred?

Therefore it is crucial to identify the person that is 'in command' in relation to an autonomous ship. If the pilot has control of the autonomous ship, it may not be possible for the SBO, who is not only not on board beside the pilot but quite possibly in another country altogether, to wrest control back again in the event the pilot appears to be in error.

6.1 Exemption from pilotage

The AAWA project suggests that to overcome this issue, either the SBO could become a licensed pilot for compulsory pilotage areas, or alternatively, the autonomous ship could be given an exemption from the pilotage requirement.¹⁵² This will not always be a viable option. In the United States of America, each state has its own pilotage law and regulations. A brief

¹⁵⁰ *Oceanic Crest Shipping v Pilbara Harbour Services* (1986) 160 CLR 626.

¹⁵¹ Per Gibbs CJ, *Oceanic Crest Shipping v Pilbara Harbour Services* (1986) 160 CLR 626, 642.

¹⁵² AAWA, 'Remote and Autonomous Ships – The next steps' (Position Paper, Rolls-Royce plc, 2016), 12.

canvass of some of these state laws reveals that, in some states, foreign-flagged vessels engaged in trade cannot be exempt from compulsory pilotage.¹⁵³

Some port authorities grant a pilotage exemption to the master or first mate of a vessel while others exempt the vessel itself. Examples of common law jurisdictions that issue pilotage exemptions to an individual rather than the vessel are the United Kingdom,¹⁵⁴ Australia,¹⁵⁵ New Zealand,¹⁵⁶ Canada¹⁵⁷ and Malaysia.¹⁵⁸

In the United Kingdom the Pilotage Act 1987, permits:¹⁵⁹

a competent harbour authority to grant a pilotage exemption certificate to a bona fide master or first mate of any ship if it is satisfied by examination or other requirements it may reasonably impose, that the person's skill, experience and local knowledge are sufficient for the person to be capable of piloting the ship within its harbour.

For example, if an autonomous ship were to berth in Southampton, the person deemed to be the master or the first mate would apply to Associated British Ports for an exemption under their Pilotage Directions.¹⁶⁰ In order to qualify, the person must pass an examination, complete on board assessments and undertake a prescribed number of acts of pilotage and assessment/familiarisation acts within the preceding 12 months.¹⁶¹ The number varies according to the type of vessel.

These directions will make it difficult for a SBO to qualify. First, the proposed designs of autonomous ships make it impossible for the master or first mate to physically board the ship. Second, if pilotage requires the pilot be on board,¹⁶² pilotage is in fact impossible. Further,

¹⁵³ See for example Washington State, Revised Code of Washington (RCW) Section 88.16.070, New York, Navigation Law §§ 88, 89a, 89b.

¹⁵⁴ Pilotage Act 1987 (UK), s 8.

¹⁵⁵ Navigation Act 2012 (Cth), s 172.

¹⁵⁶ Maritime Rules 2011 Part 90 (New Zealand).

¹⁵⁷ Pilotage Act RSC 1985, c P-14 (Canada) s 22.

¹⁵⁸ Port Authorities Act 1963 (Malaysia) s 29.

¹⁵⁹ Pilotage Act 1987(UK), s 8(a).

¹⁶⁰ Associated British Ports – Southampton, Competent Harbour Authority Pilotage Area, Pilotage Directions 3.1

¹⁶¹ Associated British Ports – Southampton, Competent Harbour Authority Pilotage Area, Pilotage Directions 3.1, Schedule No 2, 2.1.

¹⁶² This is the case in India. The Indian Port Act 1908 provides: s 31(1) No vessel of the measurement of two hundred tons or upwards shall enter, leave or be moved in any port to which this section has been

there can be no on board assessments. Third, it is not clear if the SBO is in fact a master. The directions will have to be reworked in order for the SBO to be granted a pilotage exemption certificate.

The other option is to grant an exemption to the ship. Singapore grants the pilotage exemption to the ship itself,¹⁶³ as do South Africa,¹⁶⁴ Hong Kong,¹⁶⁵ and India.¹⁶⁶

Singapore's Maritime and Port Authority (MPA) has a broad discretion when determining whether to issue an exemption certificate: 'if it appears to the Authority to be necessary, exempt any vessel or class of vessels while navigating in any pilotage district from being under pilotage subject to such conditions as it may think fit to impose.'¹⁶⁷ In practice the MPA, before granting an exemption to a vessel, requires at a minimum that the master has completed a Pilotage Exemption Course and that the ship is equipped with VHF.¹⁶⁸ The master may also need to have had prior experience navigating in the compulsory pilotage area.

The significant difference between pilotage exemptions under Singaporean, South African, Hong Kong and Indian law, as contrasted with the other common law jurisdictions,¹⁶⁹ is that these jurisdictions permit exemptions to vessels or classes of vessels rather than to an individual person. Therefore, those laws allow more readily for an exemption to be granted for an autonomous ship.

The granting of pilotage exemptions varies from state to state and port to port. As 'the essence of pilotage is knowledge of local circumstances';¹⁷⁰ the pilot's purpose is to provide

especially extended without having a pilot, harbour-master or assistant of the port-officer or harbour-master *on board*. (Emphasis added).

¹⁶³ Maritime and Port Authority Act (Singapore, cap 170A, 1997 rev ed) s 60.

¹⁶⁴ National Ports Act No. 12 of 2005 (South Africa), s 75(2) Pilotage is not compulsory in respect of any vessel or class of vessels that have been exempted from pilotage by the Authority in writing.

¹⁶⁵ Pilot Ordinance permits the authority to exempt a ship from compulsory pilotage if 'compliance with the requirement is unnecessary in the circumstances of the case' Pilot Ordinance (Cap 84) (Hong Kong) s 10D(3)(b).

¹⁶⁶ It should be noted that an exemption can only be granted to a vessel under 200 tons. Indian Port Act 1908 s 31(1).

¹⁶⁷ Maritime and Port Authority Act (Singapore, cap 170A, 1997 rev ed) s 60.

¹⁶⁸ Maritime and Port Authority of Singapore, General Information (General requirements to Qualify for Pilot Exemption) <<http://www.mpa.gov.sg/web/portal/home/port-of-singapore/port-operations/pilotage/pilotage-exemption/general-information-general-requirements-to-qualify-for-pilot-exemption>> accessed 22 May 2017.

¹⁶⁹ United Kingdom, Australia, New Zealand, Canada and Malaysia as discussed above.

¹⁷⁰ Francis Rose, *The Modern Law of Pilotage* (Sweet and Maxwell, 1984) 1.

local knowledge and advise the ship's master. Thus, it is questionable whether the SBO in a shore control centre in another country can be granted an exemption from compulsory pilotage unless they have the requisite experience in each port that the autonomous ship may visit. Further, in some states, the person applying for the exemption must not only have the required experience and knowledge but also be a citizen of that country¹⁷¹ or entitled to reside permanently in that country.¹⁷²

6.2 Remote Pilotage

An alternative option for the autonomous ship is remote pilotage or shore-based pilotage.¹⁷³ While there is no one definition of remote pilotage it is understood to mean 'an act of pilotage, carried out by a licensed pilot, from a position that is not on board the ship that is subject to the pilotage'.¹⁷⁴ It is not commonly used and both the International Maritime Pilots Association and European Maritime Pilots Association argue that it cannot be a substitute for pilotage performed by a pilot on board.¹⁷⁵ Hadley and Pourzanjani highlight that 'the appropriate legislative framework is not yet in place, and the issue of liability is unresolved.'¹⁷⁶ Pilotage is a singularly national issue and while in some countries remote pilotage is used,¹⁷⁷ usually when weather conditions are too severe to permit the pilot to board safely,¹⁷⁸ in others it has been described as an 'oxymoron'.¹⁷⁹

¹⁷¹ For example in Canada. See Pilotage Act RSC 1985, c P-14 (Canada) s 22(2).

¹⁷² Western Australian law requires the person apply for the exemption to be entitled to be a permanent resident: Port Authorities Regulations 2001 (WA) r 49(1).

¹⁷³ AAWA, 'Remote and Autonomous Ships – The next steps' (Position Paper, Rolls-Royce plc, 2016), 12.

¹⁷⁴ Karl Bruno and Margareta Lutzhoft, 'Shore-based Pilotage: Pilot or Autopilot? Piloting as a Control Problem' (2009) 62 *Journal of Navigation* 427.

¹⁷⁵ Mike Hadley and Malek Pourzanjani, 'How Remote is Remote Pilotage?' (2003) Vol 2 Issue 2 *WMU Journal of Maritime Affairs* 181, 184.

¹⁷⁶ Mike Hadley and Malek Pourzanjani, 'How Remote is Remote Pilotage?' (2003) Vol 2 Issue 2 *WMU Journal of Maritime Affairs* 181, 182.

¹⁷⁷ In particular Germany and The Netherlands. See discussion in Mike Hadley and Malek Pourzanjani, 'How Remote is Remote Pilotage?' (2003) Vol 2 Issue 2 *WMU Journal of Maritime Affairs* 181, 183.

¹⁷⁸ Karl Bruno and Margareta Lutzhoft, 'Shore-based Pilotage: Pilot or Autopilot? Piloting as a Control Problem, (2009) 62 *Journal of Navigation* 427, 428.

¹⁷⁹ Mike Hadley and Malek Pourzanjani, 'How Remote is Remote Pilotage?' (2003) Vol 2 Issue 2 *WMU Journal of Maritime Affairs* 181, 182 citing Department for Environment, Transport and Regions (DETR): *Review of the Pilotage Act 1987* London: The Stationery Office, 1998.

A remote pilot's role may seem akin to that of an air traffic controller. However, traffic control is only cursorily similar – there are international navigation laws that apply regardless of jurisdiction and there is global uniformity that is not present in ports. There are international standards of airport layout and design and navigational procedures,¹⁸⁰ whereas pilotage regulations vary not only from country to country but port to port.

If a pilot takes full remote control of the operation of the autonomous vessel, who ought to be liable for their negligence? When piloting *on board* a ship, the pilot is deemed the servant of the shipowner and has full control of the navigation of the ship while the master remains in overall command. Therefore the shipowner is vicariously liable for any loss or damage as result of the pilot's negligence. However, a study into remote pilotage by the Chalmers University of Technology¹⁸¹ concluded that the information fed back to a pilot on-shore is inferior to information fed back to a pilot on the bridge and therefore the pilot's control of the ship is reduced.¹⁸² It is difficult to see how the pilot can be considered the servant of the shipowner when the pilot is not on board, beside the master who has command of the vessel (unless the shore control centre can take over) and is navigating with poorer quality information than that fed back to an on-board pilot.

On the other hand, the quality of the information provided to the pilot by an autonomous ship system will be equivalent to the information supplied to the SBO and arguably the remote pilot will have the same level of control as the SBO. The Chalmers University of Technology study conducted focus groups with Vessel Traffic Service (VTS) operators, 'who claimed that from their point of view a significant percentage of the ships trading in the port of Göteborg were so well equipped and had such competent crews that they would do just as well without a pilot onboard.'¹⁸³

¹⁸⁰ Karl Bruno and Margareta Lutzhoft, 'Shore-based Pilotage: Pilot or Autopilot? Piloting as a Control Problem' (2009) 62 *Journal of Navigation* 427, 435.

¹⁸¹ Karl Bruno and Margareta Lutzhoft, 'Shore-based Pilotage: Pilot or Autopilot? Piloting as a Control Problem' (2009) 62 *Journal of Navigation* 427.

¹⁸² Karl Bruno and Margareta Lutzhoft, 'Shore-based Pilotage: Pilot or Autopilot? Piloting as a Control Problem', (2009) 62 *Journal of Navigation* 427, 431.

¹⁸³ Karl Bruno and Margareta Lutzhoft, 'Shore-based Pilotage: Pilot or Autopilot? Piloting as a Control Problem', (2009) 62 *Journal of Navigation* 427, 432.

If the person on-shore is simply providing shore-based tactical advice¹⁸⁴ and not a pilot at all they will not enjoy the limitation of liability afforded to an on-board pilot, as they are outside the scope of the legislative provisions. Instead they will be subsumed by the port's VTS.¹⁸⁵ If a VTS operator (as a servant of the port authority) fails to exercise reasonable care and skill in carrying out their function the port authority will be liable.¹⁸⁶ Further, if the VTS is considered an aid to navigation the port authority may be held liable should their advice be wrong and relied upon.¹⁸⁷ This question of liability must be resolved before autonomous ships can enter foreign ports.

7 Conclusion

Before autonomous ships enter operation commercially, there are significant legal hurdles to overcome. The lack of an on-board crew may make the autonomous ship unseaworthy. This needs to be clarified or the shipowners risk significant liability for any damage to, or loss of, cargo. The 'nautical exception' defence in the Hague-Visby rules may be ineffective (unless the SBO is regarded as the 'master' of the vessel), and the lack of a crew may even leave the shipowner without insurance cover.

The autonomous ship cannot comply with Rule 5 of COLREGs unless the lookout by sight and hearing requirement is satisfied by the use of audio-visual methods. Further, the SBO must be in a position to respond appropriately in complex and changing situations. Unless the autonomous ship can maintain a proper lookout and react to potential collision situations with at least the same level of skill and intuition as an experienced mariner, COLREGs will need to be amended to allow autonomous ships to operate legally.

¹⁸⁴ Mike Hadley and Malek Pourzanjani, 'How Remote is Remote Pilotage?' (2003) Vol 2 Issue 2 WMU Journal of Maritime Affairs 181.

¹⁸⁵ Vessel traffic services - VTS - are shore-side systems which range from the provision of simple information messages to ships, such as position of other traffic or meteorological hazard warnings, to extensive management of traffic within a port or waterway. <<http://www.imo.org/en/OurWork/safety/navigation/pages/vesseltrafficservices.aspx>> accessed 22 May 2017.

¹⁸⁶ R P A Douglas and G K Geen, *The Law of Harbours and Pilotage*, (1993) Lloyd's of London Press 4th ed, 61 citing *East London Harbour Board v Caledonian Shipping Co* [1908] AC 271.

¹⁸⁷ Russell MacWilliam and Darryl Cooke, 'VTS: lifting the fog of legal liability', [2006] Lloyd's Maritime and Commercial Law Quarterly 362 citing *Irish Shipping Ltd v. Canada* [1977] 1 FC 485.

Maritime law places significant responsibility on the master. To whom or where those responsibilities will be allocated, and in which contexts or circumstances, must be made clear. The SBO may find themselves exposed not only for civil liability claims but criminal prosecution if the law deems that they are the 'master' of the autonomous vessel.

Compulsory pilotage renders the autonomous ship useless in cargo carrying if it cannot comply with or be exempted from pilotage law in the port states where it is expected to operate. In the early stages of autonomous ship operations, it is likely that international voyages will only be undertaken between countries that have agreed bilaterally to allow the ships to operate.¹⁸⁸ However, if autonomous shipping is to develop beyond such specific bilateral arrangements, the legal issue of how unmanned ships are to be piloted, or exempted from pilotage, will need to be resolved at an international level.

Doubtless many more issues will arise as the projects develop, but if the maritime industry sees commercial benefits to autonomous ships, legal solutions are likely to be found. International maritime law has proved to be flexible enough to adapt to technological advances in the past but whether there is enough impetus for this particular development remains to be seen.

¹⁸⁸ Splash 247, 'Kongsberg: Short Sea Trades will lead autonomous shipping revolution' 11 May 2017 <<http://splash247.com/kongsberg-short-sea-trades-will-lead-autonomous-shipping-revolution/>> accessed 22 May 2017.