A Pioneering Study of Third-party Liability Insurance for Unmanned/Autonomous Commercial Ships[1]

Ling Zhu[2] and Richard W. W. Xing[3]

Abstract:

The technologies needed to operate unmanned/autonomous merchant ships already exist, though they are still in need of further refinement and fine-tuning. Shipping evolution always brings with it changes and new risks. Operations of unmanned/autonomous commercial ships may therefore impact on the regime of third-party liability insurance, which provides cover for various kinds of maritime liabilities currently either imposed by law or voluntarily undertaken under the terms of the contract. Hence, it is necessary to investigate the changes and potential risks associated with unmanned/autonomous ships of different levels of autonomy. It is also important to consider the new changes and potential risks from the perspective of P&I insurance, and examine the core elements of liability insurance for unmanned/autonomous ships, including their legality and seaworthiness/classification. After thoroughly investigating insurance for different liabilities, including collision liability, cargo liability and pollution liability, it is concluded that, although there will be unavoidable challenges, the introduction of unmanned/autonomous merchant ships will not, however, result in any significant impact on liability insurance practice.

Keywords:

Third-party Liability Insurance, Unmanned/Autonomous Commercial Ship, P&I Club Cover, Shore-based Operator, Different Autonomy Levels (ALs)

---

[1] The writing of this paper was financially supported by a research grant awarded by the Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University (Account Code: G-UADQ).

[2] Associate Professor in Shipping Insurance and Law, Department of Logistics and Maritime Studies, Faculty of Business, The Hong Kong Polytechnic University.

[3] BA, BL, LL.M., Ph.D. Research Assistant (March-June 2018), Department of Logistics and Maritime Studies, Faculty of Business, The Hong Kong Polytechnic University.

I. Introduction

The origin of ships can be traced back to about 6,000 years ago, when the Egyptians used reed boats for hunting, fishing, warfare and religious rites.[4] Roman and Viking ships saw an improvement in construction, being built of planks, which enabled them to be navigated longer.[5] The invention of sails allowed a boat to sail longer with heavier loads and supplies, and square sails, best suited for sailing down wind, as well as fore-and-aft sails, were devised later.[6] With the increasing need for international trade, the ship continued to be developed throughout the 19th Century, and the *Liverpool*, the largest British sailing ship of the year 1890, was built of iron with steel beams.[7] Right down to modern times, various kinds of commercial ships have been developed for transporting different types of cargos, and being equipped with smart facilities and systems, so that sailing at sea is becoming less risky and laborious. Since the evolution of ships has always followed closely alongside the development of technology, unmanned/autonomous ships are believed to be the next generation of ships, and much scientific research is accordingly underway.[8]

As for the definition of unmanned/autonomous ships, as the name suggests, an unmanned ship indicates that no crew are on board the ship; whereas autonomous ships will possibly have less crew on board, depending on the degree of advancement of the modular control systems and communications technology.[9] As a matter of fact, in 2016 Norway opened the first test area in the world for unmanned ships.[10] In addition, two other governments, Finland[11] and Australia,[12] have also already designated marine water areas for testing autonomous ship technology. Also, in view of the rapid technological developments relating to the operation of ships in various autonomous/automated modes, the Maritime Safety Committee (MSC), at its latest session, recognized that the International Maritime Organization (IMO) should take a proactive and leading role in regulatory scoping exercises on Maritime Autonomous Surface Ships (MASS).[13]

---

[4] D. Forde, *Ancient Mariners: The Story of Ships and Sea Routes* (Bremen: Maritime Press, 2015) 13.

[5] H. H. Brindley, 'The Evolution of Shipping' (1921) 7(8) *The Mariner's Mirror* 228.

[6] E K. Chatterton, *Sailing Ships and Their Story: The Story of Their Development from the Earliest Times to the Present Day* (London: Sidgwick & Jackson, Ltd. 1915) 198.

[7] ibid 273.

[8] T. Porathe, H. C. Burmeister, Ø. J. Rødseth, 'Maritime Unmanned Navigation through Intelligence in Networks: The MUNIN Project' (2013), presented at: *12th International Conference on Computer and IT Applications in the Maritime Industries*, COMPIT'13, 177-183.

[9] Ø. J. Rødseth, H. C. Burmeister, 'Developments toward the Unmanned Ship' (2012) *Proceedings of International Symposium Information on Ships–ISIS* 30-31.

[10] Norway opened the first test area for unmanned ships in the world in 2016, and now it has three test areas for unmanned ships, namely, Trondheim fjord, Sunnmøre region, and the Oslofjord. At https://worldmaritimenews.com/archives/237297/norway-opens-new-test-area-for-autonomous-ships/ (last accessed 25 June 2018).

[11] Finland opened its first test area for autonomous ships in August 2017. At https://worldmaritimenews.com/archives/227275/first-test-area-for-autonomous-ships-opened-in-finland/ (last accessed 25 June 2018).

[12] The Australian Maritime Safety Authority granted a request for the operation of a remotely operated unmanned ship in Australian waters in August 2017, see Working Boats issue 11 by AMSA 299 on 8 February 2018, 15, at https://www.amsa.gov.au/news-community/newsletters/working-boats-issue-11 (last accessed 25 June 2018).

[13] IMO. Maritime Safety Committee (MSC), 99th session – Media information, at http://www.imo.org/en/MediaCentre/IMOMediaAccreditation/Pages/MSC99preview.aspx (last accessed 25 June 2018).

Unmanned/autonomous ships have already been operated by States and used exclusively on non-commercial services by national governments.[14] Introducing unmanned ships to commercial shipping is an ongoing development trend that will surely bring changes and new risks, although it is still under debate as to the types of new risks that may arise in relation to the operation of unmanned/autonomous commercial ships. New risks may arise, but not exclusively, from software bugs and cyber-attacks,[15] IT and communication problems, on-the-spot decision-making in dynamic environments, pirates, or from accidents, such as fire accidents at sea and the time that may be involved in reaching a ship if the controlling computer malfunctions.[16]

Ideally, any maritime adventure shall be protected. This recognition started from maritime loans that existed in ancient Babylon and were subsequently used by the Phoenicians, ancient Greeks, and Romans, down to the contracts of insurance invented by Northern Italians in the fourteenth century.[17] Marine Insurance, the oldest form among the various ways of protection against marine losses,[18] is a response to the expansion of sea trade,[19] and has the significant function of providing cover against losses incidental to marine adventure.[20] Risks that may be brought about by the introduction of unmanned/autonomous commercial ships have drawn the attention of both the shipping industry and international regulators.[21] These risks may put the insurance industry in a very strategic position, as it has even been suggested that insurers only have five years to determine the costs of covering an unmanned ship.[22]

This paper attempts to carry out an exploratory research to fully understand third-party civil liability insurance for unmanned/autonomous commercial ships. In order to achieve this aim, after this introduction, Section II discusses the new changes and potential risks in association with unmanned/autonomous ships of different autonomy levels. Section III focuses on the matter of whether or not the P&I clubs, as the main liability insurers for shipowners, will support the introduction of unmanned/autonomous commercial ships. Section IV explores the impact of unmanned and autonomous commercial ships on civil liability insurance. The paper then concludes that, although there will undoubtedly be new risks and insurance issues following the introduction

---

[14] R. McLaughlin, 'Unmanned Naval Vehicles at Sea: USVs, UUVs, and the Adequacy of the Law' (2011) 21 *Journal of Law, Information and Science* 100.

[15] 'Future Proofed? What Maritime Professionals Think about Autonomous Shipping?' Report by NAUTILUS Federation, A Federation of Maritime Professionals, 8, at https://www.nautilusint.org/en/news-insight/resources/nautilus-reports/autonomous-shipping-research/ (last accessed 25 June 2018).

[16] D. Mahoney, 'Underwriters Get Ready for Crewless Ships: Five-year Timeframe for Unmanned Vessels' (Business Insurance; Chicago Vol. 50, Iss. 4, Feb 15, 2016) at https://search.proquest.com/docview/1766119189?accountid=16210 (last accessed 25 June 2018).

[17] H. Bennett, *Law of Marine Insurance* (Oxford: Oxford University Press, 2006, second edition) 1-2.

[18] K. Noussia, *The Principle of Indemnity in Marine Insurance Contracts: A Comparative Approach* (Berlin: Springer Science & Business Media, 2007) 1.

[19] O. Gurses, *Marine Insurance Law* (Abingdon: Taylor & Francis, 2016) 2.

[20] English Marine Insurance Act 1906, Sec. 1.

[21] 'CMI International Working Group Position Paper on Unmanned Ships and the International Regulatory Framework' 19, at http://www.comitemaritime.org/Uploads/Questionnaires/CMI%20Position%20Paper%20on%20Unmanned%20Ships.pdf (last accessed 26 June 2018)

[22] n 16 above.

of unmanned/autonomous ships to commercial practice, this will not, however, result in any significant impact on existing liability insurance practice.

II. Unmanned/Autonomous Commercial Ships: Changes and Risks

1. Unmanned/Autonomous Ships and Their Autonomy Levels

Numerous attempts have been made to define whether or not an unmanned/autonomous ship can fall within the definition of "ship" in the existing international and domestic legal framework. For example, Veal and Tsimplis contribute a comprehensive literature review on this issue.[23] The United Nations Convention on the Law of the Sea (UNCLOS), which provides a general legal framework for ocean governance, empowers the flag State to establish the conditions for giving a ship its nationality[24] and at the same time a "competent international organization" to regulate global shipping;[25] this means that different conditions can be given under national laws and/or international conventions. Nevertheless, after having considered the legal definitions of "ship" and "vessel" in various public and private law conventions and national maritime laws, with a high degree of certainty, no significant hurdle can be found to prevent unmanned/autonomous ships from falling within the various similar definitions in international conventions;[26] this is particularly so since having a crew on board, including a master, is not generally regarded as an essential part of the notion of a ship under international law.[27]

Lloyd's Registry has contributed to describing different levels of automation of unmanned or autonomous ships. According to the Design Code of Lloyd's Register, there are seven levels,[28] the details of which can be illustrated below (see Table 1):

---

[23] R. Veal, M. Tsimplis, 'The Integration of Unmanned Ships into the *Lex Maritima'* (2017) 2 *Lloyd's Maritime and Commercial Law Quarterly* 308.

[24] UNCLOS, article 91.

[25] UNCLOS, articles 22, 41, 53 & 60. See G. K. Walker. *Definitions for the Law of the Sea: Terms not Defined by the 1982 Convention* (Leiden: Martinus Nijhoff Publishers, 2012) 138.

[26] The Nairobi International Convention on the Removal of Wrecks, 2007; the International Convention on Salvage, 1989; the 1992 Protocol to the Convention on Civil Liability for Oil Pollution Damage, 1969.

[27] E. Van Hooydonk, 'The Law of Unmanned Merchant Shipping–An Exploration' (2014) 20.3 *The Journal of International Maritime Law* 406. See also, Danish Maritime Authority, Analysis of Regulatory Barriers to Autonomous Ships: Final Report, (2017) 37.

[28] Lloyd's Register, Design Code for Unmanned Marine Systems, February 2017, section 4.1.2, at https://www.lr.org/en/latest-news/new-code-to-certify-unmanned-vessels-announced/ (last accessed 25 June 2018).

Table 1 Autonomy Levels of Ships as Adapted from Lloyd's Register

(Sources: Lloyd's Register)

Autonomy Level	**Description**
AL0: Manual Control	No autonomous function, and humans control all actions. All action and decision-making is performed manually (N.B. systems may have a level of autonomy, with Humans in/on the loop.).
AL1: Decision Support On-board	All actions taken by human Operator, but the decision support tool can present options or otherwise influence the actions chosen. Data is provided by systems on board.
AL2: On & Off-board Decision Support	All actions taken by human Operator, but decision support tool can present options or otherwise influence the actions chosen. Data may be provided by systems on or off board.
AL3: Execution By Operator Who Monitors and Authorizes Actions	"Active" Human in the loop: Decisions and actions are performed with human supervision. Data may be provided by systems on or off-board.
AL4: Execution By Operator Who Monitors and Is Able to Intervene	Decisions and actions are performed autonomously with human supervision. High impact decisions are implemented in a way to give human Operators the opportunity to intercede and over-ride.
AL5: Monitored Autonomy	Rarely supervised operation where decisions are entirely made and actioned by the system.
AL6: Full Autonomy	Unsupervised operation where decisions are entirely made and actioned by the system during the mission.

The above-described Autonomy Levels (AL) are adapted from the Lloyd's Register guidance document, which tries to draft a ShipRight Procedure for autonomous ships.[29] From AL0 to AL6, the role of "human" is changing. As shown in the table, for AL2 to AL4, no crew needs to be on board, and the shore-based vessel operator (hereafter the operator) takes charge of the navigation. For AL5 and AL6, there is no need even for the operator to intervene in the navigation.

Since the definition of "unmanned/autonomous ship" awaits further clarification, it is sensible that a discussion of unmanned/autonomous ships should include ships with different ALs,[30] smart ships, ships with an E-navigation system[31], unmanned ships and other possible terms. This paper is thus concerns with unmanned/autonomous ships in a broad sense.

---

[29] Lloyd's Register, Cyber Enabled Ships: Draft ShipRight Procedure - Autonomous Ships, First edition, July 2016, 2, at http://info.lr.org/l/12702/2016-07-07/32rrbk (last accessed 25 June 2018).

[30] n 28 above.

[31] E-navigation is defined by the IMO as "the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment." At:

2. Changes and Potential Risks

The very obvious changes that may be brought about by the introduction of unmanned/autonomous ships include: 1) No crew or less manpower will be needed on board for sailing, so questions relating to the ship's definition and manning may arise; 2) new parties will progressively participate in its operation and navigation; for example, the operator, including both on-board and shore-based vessel operators of unmanned/autonomous ships; it thus becomes necessary to consider the roles played by new parties; and 3) computer technologies will be highly relied upon for the operation and navigation of unmanned or autonomous ships, which raises concerns about the safety of navigation. This concern has been proven since a survey report by NAUTILUS Federation, which highlights eleven safety risks, mainly including the safety of software maintenance and actual navigation safety.[32]

Changes bring about risks. When discussing the concerns of underwriters, Mahoney mentioned three kinds of potential risks in relation to unmanned/autonomous ships.[33] The first one is related to piracy issues. It is argued that the introduction of unmanned/autonomous ships would decrease piracy, because there would not be any crew to take as hostages, and also no unauthorized operation would be permitted. However, some experienced crews also hold the view that an unmanned vessel at sea would be at higher risk of piracy.[34] The second kind of potential risk would be that since no one would be on board, then there might be a lack of preventive measures; for example, no one is there to inspect the cargo and make sure it does not leak or break through and cause a fire. The third kind of risk would be that it might take a longer time to reach the ship if there was a computer malfunction or if it were involved in any sudden incident.[35] The unavailability of any reliable data further confuses the insurance underwriters at the present stage.

Such changes and potential risks highlight the necessity to first clarify three issues: 1) What would be the roles played by the operator? 2) Would there be any need to promote product liability insurance for the software designers and manufacturers? and 3) Who should take out insurance to cover piracy and cyberattacks?

A. The Role of the Operator

The role of operator would change due to the replacement of masters, ships' officers and crews by artificial intelligence assisted by operators in such unmanned/autonomous ships.[36] According to the Lloyd Register's AL classification (see Table 1), unmanned/autonomous ships may no longer need any master and/or any crew in the traditional sense; instead, an operator either on or off board

http://www.imo.org/en/OurWork/safety/navigation/pages/enavigation.aspx (last accessed 25 June 2018).

[32] n 15 above.

[33] n 16 above.

[34] With 23 years in the Merchant Marines, including 13 as captain of five vessels, Mr. Kinsey said: "I believe that a human presence on board with active piracy measures in place is an effective deterrent to a pirate boarding." See ibid.

[35] ibid.

[36] Hooydonk, n 27 above. 423.

would play an important role. As a consequence, the operator might have different roles, such as a master[37] or an employee of the shipowner[38], as follows:

1) When he/she works on board, for instance, as described in AL1 and AL2, the operator would have similar functions to those of a master, as in the normal classic situations;

2) When the operator works off board, in the case, for instance, being described from AL2 to AL4, he/she needs to monitor, authorize and intervene in the navigation. One could argue here that he/she should be treated either as the master or as an employee of the shipowner;[39] and

3) In the case where the operators can monitor, but cannot intervene in the navigation, they may only be admitted as being an employee of the shipowner.

In addition, the operator may function as the shipowner in some cases. "Operator" is included in the definition of "shipowner" in various international conventions and national legislations. For instance, in the Maritime Labour Convention 2006 (MLC), "shipowner" is defined as "…the owner of the ship or another organisation or person, such as the manager, agent or bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner and who, on assuming such responsibility…"[40] Under the International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001 (Bunker Convention), it is clearly stated that the shipowner includes "the registered owner, bareboat charterer, manager and operator of the ship".[41] On a domestic level, for instance, the term "owner or operator of a vessel" is defined in U.S. law as "any person owning, operating, or chartering by demise, such vessel".[42] Nevertheless, it is argued that the scope of "operator" is subject to judicial determination on a case-by-case basis.[43] The owner of the ship might be the operator himself, though this is not always the case.[44] After all, the ship operator is usually associated with the operation of the ship, while the shipowner is linked to the ownership of the ship; thus, if the operator owns the vessel then he may also fall within the definition of "shipowner". Once the operator of an unmanned/autonomous ship falls within the definition of shipowner, he/she should also likely comply with certain international obligations, such as the obligation to maintain the safe operation of the ship under "the International Convention for the Safety of Life at Sea" (SOLAS),[45] and the obligation of training, certification

---

[37] A master is a physical person, who is responsible for a ship (and any person or thing on board the ship) as well as for the enforcement of the flag State's acts and regulations. See n **Error! Bookmark not defined.** above, 65. See also J. Cartner, R. Fiske, T. Leiter, *The International Law of the Shipmaster* (London: Informa Law, 2009) 86.

[38] The employees of the shipowner are the people who have contracts with the shipowner and work for the ship no matter on board or off board, including the seafarer, manager, operator, and others.

[39] E. Van Hooydonk, n 27 above. 412. See also: n 23 above. 317.

[40] MLC, 2006, Article II, 1, (j). "…shipowner means the owner of the ship or another organization or person, such as the manager, agent or bareboat charterer, who has assumed the responsibility for the operation of the ship from the owner and who, on assuming such responsibility, has agreed to take over the duties and responsibilities imposed on shipowners in accordance with this Convention, regardless of whether any other organization or persons fulfil certain of the duties or responsibilities on behalf of the shipowner."

[41] Bunker Convention, 2001, Art. 1.3.

[42] 46 U.S. Code § 70101 – Definitions.

[43] X. Chen, *Limitation of Liability for Maritime Claims: A Study of US Law, Chinese Law, and International Conventions* (Leiden: Martinus Nijhoff Publishers, 2001) 8.

[44] L. Zhu, *Compulsory Insurance and Compensation for Bunker Oil Pollution Damage* (Berlin: Springer, 2007) 139.

[45] SOLAS, CHAPTER IX, Management for the safe operation of ships, Regulation 1 (2).

and watchkeeping for seafarers under "the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 1995" (STCW).[46] He/she should also at the same time bear the liabilities as shipowner.

B. Software Designers and Manufacturers

IT, software and communications systems are deemed to be extremely important for the successful operation of unmanned/autonomous ships. Hence the computer software designers and manufacturers also play important roles. Pertinent questions are thus raised as to the liability of such parties to third parties, and concerning the basis for their liability.[47] The answers to these questions may vary from one jurisdiction to another.

As far as the liability of such involved parties to a third party goes, software designers and manufacturers may have to bear product liability to the extent that their products and services cause injuries to persons or damage to objects. A similar issue has been discussed with regard to driverless cars in the UK, which gives us some insightful thoughts. As part of the proposal to create the first driverless car legislation, the allocation of civil liability between the driver and manufacturer was reviewed.[48] It was suggested that the designer, together with the manufacturer, should bear liability if the occurrence of an accident was due to any product design defect, even whilst a driver was operating the car.[49] Therefore, by the same rule, liability stemming from an incident involving an autonomous/unmanned ship would also perhaps have to be apportioned between the relevant parties, such as the software designer together with manufacturer and the shipowner.[50]

C. Piracy and Cyber Security

In the coming age of unmanned/autonomous shipping, it is hard to expect that pirates and terrorists will disappear from the high seas.[51] Moreover, unmanned/autonomous navigation may be even easier to be hacked, and even simple technical errors could cause severe accidents.[52] The cybersecurity of shipping has been heatedly debated in the MSC's meetings at IMO. In its 98th session, the MSC adopted a resolution on maritime cyber risk management in safety management systems.[53] It is reported that significant weaknesses have been identified in the cybersecurity of critical technology used for navigation at sea, such as GPS (Global Positioning System), AIS

---

[46] 1995 Amendments to the annex to the STCW, 1978, Regulation I/I, 1. 23.

[47] n 21 above.

[48] Government to review law before self-driving cars arrive on UK roads, at https://www.theguardian.com/technology/2018/mar/06/self-driving-cars-in-uk-riding-on-legal-review (last accessed 25 June 2018).

[49] Unmanned And Autonomous Vessels – The Legal Implications from P&I Perspective, at https://www.shipownersclub.com/autonomous-vessels/ (last accessed 25 June 2018).

[50] This is also analysed in: n 21 above.

[51] E. Van Hooydonk, n 27 above. 418.

[52] n 16 above.

[53] Maritime Safety Committee (MSC), 98th session, 7-16 June 2017, at http://www.imo.org/en/MediaCentre/MeetingSummaries/MSC/Pages/MSC-98th-session.aspx (last accessed 25 June 2018).

(Automatic Identification System), ECDIS (Electronic Chart Display and Information System), and other relevant aspects.[54]

There is a risk that any component of an IT system or a computer linked to the Internet controlling an unmanned/autonomous ship may possibly be hacked. Having said that, it is clear that the risk of being cyberattacked is not unique to maritime risk, since an unmanned/autonomous ship can be cyber attacked anywhere, not necessarily during a marine adventure. As a matter of fact, there even now lacks provisions in marine insurance in relation to cyber risk.[55] The insurability of this kind of risk would undoubtedly be a major concern.[56]

III. Unmanned/Autonomous Commercial Ships and P&I Insurance

In general, insurance can be categorized as including: 1) cargo insurance, 2) freight insurance, 3) hull and machinery insurance (H&M), and 4) protection and indemnity insurance (P&I).[57] Cargo insurance, freight insurance, and H&M insurance (which covers some of the liabilities related to ships) are basically regarded as property insurance for covering the loss of or damages to the property; whereas the P&I insurance provided by the shipowners' Clubs is a primary means for shipowners to protect themselves against third-party claims.[58] Thirteen principal underwriting associations, which comprise the International Group, provide shipowners' liability insurance for approximately 90% of the world's ocean-going tonnage.[59] The issue as to whether or not P&I clubs will accept the entry of unmanned/autonomous ships has been under debate, and some clubs have already expressed their willingness to cover this new invention.[60] With the entry of unmanned/autonomous ships being at issue, it is necessary for P&I clubs to consider the changes and potential risks, as discussed above. Also, among the many and differing important aspects involved, it is important to firstly examine the legality and seaworthiness/classification of an unmanned/autonomous commercial ship.[61]

---

[54] Marsh LLC, 'The Risk of Cyber Attack to the Maritime Sector' July 2014, 3, at https://www.marsh.com/uk/insights/research/the-risk-of-cyber-attack-to-the-maritime-sector.html (last accessed 25 June 2018).

[55] Marsh LLC, 'Cyber Gap Insurance Cyber Risk: Filling the Coverage Gap' July 2014, 3, at http://www.oliverwyman.com/content/dam/marsh/Documents/PDF/UK-en/Cyber%20Gap%20Insurance%20Cyber%20Risk%20Filling%20the%20Coverage%20Gap-07-2014.pdf (last accessed 25 June 2018).

[56] It is worth considering how the risks can be shared among various types of marine insurance; or, whether or not some new insurance products on cyber risks need to be developed for unmanned/autonomous ships.

[57] L. Zhu, 'Probing Compulsory Insurance for Maritime Liability' (2014) 45 *Journal of Maritime Law and Commerce* 65.

[58] H B. Hurd, The Law and Practice of Marine Insurance Relating to Collision Damages and Other Liabilities to Third Parties and Maritime Conventions on Limitation of Shipowner's Liability and Other Subjects (London: Sir Isaac Pitman & Sons, 1952) 147-148.

[59] International Group of Protection & Indemnity Clubs, at https://www.igpandi.org/about (last accessed 25 June 2018).

[60] P & I Cover for Autonomous Vessels, at: https://www.shipownersclub.com/autonomous-vessels/ (last accessed 25 June 2018).

[61] S. J. Hazelwood, D. Semark, *P & I Clubs: Law and Practice* (London: Lloyd's List, 2010) para. 12.4.

1. P&I's Perspective on the Changes and Potential Risks

For P&I clubs to consider insurance coverage for unmanned/autonomous commercial ships, the changes and potential risks discussed above will inevitably have to be taken into account.

First and foremost, the P&I clubs must consider the three categories of changes and potential risks, as discussed above. First, the relationships among different kinds of insurance might be debated. Marine insurance, as the name suggests, insures against the marine losses incidental to maritime adventure.[62] Some risks arising from the operation of unmanned/autonomous ships may not be covered by marine insurance, such as product liability insurance for the software designers and manufacturers.[63] Also, cybersecurity insurance is excluded from marine insurances.[64] However, in this respect it is argued that "…P&I clubs …cover P&I claims that result from a cyber-attack unless the attack is an act of war or, more likely, the work of terrorists."[65] Therefore, the question remains as to whether or not the P&I would provide cover for the risks related to the cybersecurity of an unmanned/autonomous commercial ship. Moreover, questions may arise as to the legal status of "operator", and the liability coverage that can be provided by the P&I clubs. The purpose of P&I insurance is broadly described as providing insurance to shipowners in respect of the operation of the vessel insured, which often provides that the club agrees to cover its members who are the owner or operator of the entered vessel.[66] As long as the status of "operator" can be clarified in the case where an unmanned/autonomous ship is involved, there would not be a significant change to P&I insurance, although the involvement of any new identity may lead to complications on calculating the potential risks.

2. Legality of the Adventure

In marine insurance, both the subject matter insured (for example, ship, freight, cargo) and the adventure insured must be lawful; and the adventure itself must be performed lawfully. [67] That the adventure insured shall be a lawful one and will be carried out in a lawful manner is generally phrased in Club Rules in the form of an exception.[68] That means, for instance, that claims arising from carriage of contraband, blockade running or from any other unlawful trade are usually excluded from club cover under the clubs' general exclusions regarding unlawful or illegal

---

[62] English Marine Insurance Act 1906, Art. 1.

[63] For product liability insurance, it is the insurance for the software designers and manufacturers, who are not classified as being the "shipowner", that will be excluded by the P&I cover.

[64] For instance, Institute Cyber Attack Exclusion Clause CL380, Terrorism Form T3 LMA3030 Exclusion 9, and Electronic Data Exclusion NMA2914.

[65] n 54 above, 6, "…In those circumstances the clubs exclude cover for liability directly or indirectly caused by the use or operation as a means of inflicting harm of any computer." at https://www.marsh.com/uk/insights/research/the-risk-of-cyber-attack-to-the-maritime-sector.html (last accessed 25 June 2018).

[66] n 61 above, para. 12.38.

[67] B. Soyer, *Warranties in Marine Insurance* (Abingdon: Routledge-Cavendish, 2001) 140. See also: English Marine Insurance Act 1906, Sec. 3(1) provides that: "… every lawful marine adventure may be the subject of a contract of marine insurance".

[68] n 61 above, para. 12.4.

trading.[69] Therefore, it is necessary for the clubs to consider the legality of the adventure when an unmanned/autonomous commercial ship is at issue.

Firstly, the legality of the "ship" shall be considered. As discussed earlier, it is clear that no significant legal barriers can be identified to prevent an unmanned/autonomous ship from falling within the definition of "ship" under existing international conventions. However, legal uncertainties still exist, since various domestic/national jurisdictions may have different legal provisions on the matter. Therefore, the legality of unmanned/autonomous ships within each respective jurisdictional water is still in doubt.

Secondly, the legality of "navigation" is another important aspect. To some extent, the legality of the ship is the pre-condition for ascertaining the legality of navigation; this means that if the legality of the unmanned/autonomous ship is admitted in a national law, then the unmanned/autonomous ship can lawfully navigate in the waters of that nation. In addition, for any adventure that is limited to one state's national water, the answer to the legality of navigation lies within that State's practices in setting up its own standards of navigation safety regarding unmanned/autonomous ships. If an unmanned/autonomous ship navigates in international waters (such as the high seas, international straits, and certain national waters in which the ships have free navigation rights), the UNCLOS is applicable or referable. For the ship's navigation on the high seas, the flag state is obliged to take necessary measures for the ship flying its flag to ensure safety at sea with regard to, inter alia, (a) the construction, equipment and seaworthiness of ships; and (b) the manning of ships, labour conditions and the training of crews, taking into account the applicable international instruments.[70] Article 94(4) of the UNCLOS further provides that each ship is in the charge of a master and officers who possess appropriate qualifications, and that the crew is appropriate in qualification and numbers for the type, size, machinery and equipment of the ship.[71] As well as other possible legal conflicts, manning issues will be a very outstanding one if fully unmanned commercial ships are introduced to the practice. Therefore, the legality of an unmanned/autonomous ship's navigation rights in international waters under the UNCLOS is questionable. However, UNCLOS also requires states to "take into account of", "conform to", "give effect to" or "implement" the relevant international rules and standards[72] developed by or through the "competent international organization"; the IMO is considered to be the "competent International organization" in the context.[73] Therefore, if the IMO instruments could be amended to introduce unmanned commercial ships, the obligations relating to manning and others under the UNCLOS would not be a big concern.

---

[69] ibid, 10.62.

[70] UNCLOS, article 94 (3).

[71] UNCLOS, article 94 (4) (b).

[72] UNCLOS, article 94 (3) (b).

[73] "The competent international organization," as used in UNCLOS Articles 22, 41, 53 and 60, means the International Maritime Organization (IMO) or its successor. n 25 above, 138. Also see: J. D. Kingham, D. M. McRae, 'Competent International Organizations and the Law of the Sea' (1979) 3.2 *Marine Policy*. A. Mihneva-Natova, 'The Relationship between United Nations Convention on the Law of the Sea and the IMO Conventions' (2005) The United Nations and the Nippon Foundation of Japan Fellow. Secretariat IMO, 'Implications of the United Nations Convention on the Law of the Sea for the International Maritime Organization' (2008) 6.10 Study by the Secretariat of the International Maritime Organization (IMO) Ⅱ, LEG/MISC, at http://www.imo.org/en/OurWork/Legal/Documents/LEG%20MISC%208.pdf (last accessed 25 June 2018).

3. Seaworthiness and Classification

The concept of seaworthiness is a core concept within marine insurance.[74] P&I clubs can avoid its liability under claims by virtue of unseaworthiness of the vessel where the member was privy to such unseaworthiness.[75] Since the requirement that an entered ship must be and remain being classed with a classification society throughout the period of entry is stated in the Club Rules, albeit with varying terms of expression,[76] the acceptance by a classification society may thus be important in ensuring a functioning insurance market for the new risks presented by unmanned/autonomous ships.[77]

Seaworthiness of a ship is a case-by-case issue. When deciding on the seaworthiness of a ship, different elements may be taken into account, including: the design and construction; machinery, equipment and navigational aids; sufficiency and competence of the crew; the sufficiency and quality of fuel; and the stowage of cargo and its stability.[78] Therefore, for unmanned/autonomous ships, the possible lack of any human physical presence on the ship and the doubts about its technical reliability are considered to be the two biggest problems and challenges in satisfying the concept of seaworthiness. Since unmanned/autonomous ships may have either no crew or less crew on board, there would be issues related to one of the core elements of the concept of seaworthiness, that of being "properly manned".[79] However, the word "properly" is open to interpretation, as proper manning depends on what is appropriate for each individual ship considering the specific type and voyage.[80] Arguably, therefore, both "no manning" and "low manning" could be appropriate. As for the technical reliability of unmanned/autonomous ships, although the safety and security of such unmanned/autonomous ships are still in doubt,[81] more and more scientific researches[82], including the project MUNIN,[83] have established that by using unmanned/autonomous ships it is hoped that accidents caused by human error will decrease.

---

[74] Danish Maritime Authority, n **Error! Bookmark not defined.** above, 92.

[75] n 61 above, para. 11.22.

[76] ibid, 11.11.

[77] Danish Maritime Authority, n **Error! Bookmark not defined.** above, 93.

[78] S. Hodges, *Cases and Materials on Marine Insurance Law* (London: Cavendish Publishing Limited, 2012) 308.

[79] L. J. Carey, 'All Hands off Deck? The Legal Barriers to Autonomous Ships' (2017) NUS Centre for Maritime Law Working Paper.

[80] n **Error! Bookmark not defined.** above, 92.

[81] K. Wróbel, J, Montewka, P. Kujala, 'Towards the Assessment of Potential Impact of Unmanned Vessels on Maritime Transportation Safety' (2017) 165 *Reliability Engineering & System Safety* 161.

[82] H. C. Burmeister, W. Bruhn, Ø. J. Rødseth (eds), 'Autonomous Unmanned Merchant Vessel and Its Contribution towards the e-Navigation Implementation: The MUNIN Perspective' (2014) 1 *International Journal of e-Navigation and Maritime Economy* 1-13. M, Wahlström, J. Hakulinen, H. Karvonen (eds), 'Human Factors Challenges in Unmanned Ship Operations – Insights from Other Domains' (2015) 3 *Procedia Manufacturing*1038-1045.

[83] The project MUNIN – Maritime Unmanned Navigation through Intelligence in Networks – as a collaborative research project, co-funded by the European Commissions under its Seventh Framework Programme, has found the following results: Unmanned vessels can contribute to the aim of a more sustainable maritime transport industry……The autonomous ship represents a long-term, but comprehensive solution to meet these challenges, as it bears the potential to: 1) Reduce operational expenses; 2) Reduce environmental impact; and 3) Attract seagoing professionals. At http://www.unmanned-ship.org/munin/about/munin-results-2/ (last accessed 25 June 2018).

Moreover, international regulators,[84] as well as several States,[85] have been trying to introduce standard guidelines and technical codes for the construction of unmanned/autonomous ships. It is thus expected that standardized safety and security will soon be in place

The concept of seaworthiness is a flexible term, and thus it has created a great degree of uncertainty and unpredictability. There have been discussions on a domestic level about the possibility of replacing the concept of "seaworthiness" with clearly defined safety and security standards. For instance, in Norway, the Norwegian Seaworthiness Act of 1903 has been replaced by the "Norwegian Ship Safety and Security Act" in 2006, which abandons the notion of seaworthiness, and introduces the concept of "safety management", derived from the ISM Code, not only for vessels' operations, but also in connection with vessel construction and engineering.[86] With subsequent developments, particularly the growing significance of safety regulations issued by the public authorities or by classification societies, it was considered that there was a declining need for a separate rule on seaworthiness, so the Nordic Marine Insurance Plan of 2013 (Version 2016) has thus entirely revoked the rule regarding unseaworthiness.[87] Therefore, if unmanned/autonomous ships can comply with the safety and security standards that will be in force, there should not be a big concern about the "seaworthiness" of such unmanned/autonomous ships.

IV. Civil Liability Insurance for Unmanned/Autonomous Ships

There are two basic types of ship's civil liability: contractual liability and third-party liability;[88] the divergence depends on whether the liability is incurred within the contract clauses or because of a third-party suffering damage or losses. It is third-party civil liability that is usually triggered by marine incidents. When a marine incident takes place at sea, collision liability, pollution liability, and other types of liability may arise. The hull insurers may cover a shipowner's liability, such as 3/4ths collision liability,[89] but P&I clubs remain as the main insurance provider for shipowners' third-party claims.[90] Despite the wide variation in risks to be covered, most of the P&I clubs insure liabilities that include collision with other ships, damage to fixed or floating

---

[84] The Maritime Safety Committee has begun to undertake a regulatory scoping exercise to determine how the safe, secure and environmentally sound operation of Maritime Autonomous Surface Ships (MASS) might be introduced in IMO instruments. See IMO, Report of the Maritime Safety Committee on Its Ninety-Eighth Session, MSC 98/23, 78-79. CMI and other organizations had already commenced a gap analysis relating to the regulatory work for the introduction of unmanned/autonomous ships. See n 21 above.

[85] UK's maritime sector body Maritime UK has launched a new Industry Code of Practice for the design, construction and operation of autonomous maritime systems. At https://www.maritimeuk.org/media-centre/news/uk-launches-industry-code-practice-autonomous-vessels/ (last accessed 25 June 2018). The Code of Practice can be found at www.maritimeuk.org/mas-cop (last accessed 25 June 2018). The Danish Maritime Authority also has published a report on analysis of regulatory barriers to autonomous ships in December 2017. See n **Error! Bookmark not defined.** above.

[86] Norwegian law - New Ship Safety Act, at: http://www.gard.no/web/updates/content/51979/norwegian-law-new-ship-safety-act (last accessed 25 June 2018).

[87] See Commentary to the Nordic Marine Insurance Plan of 2013, Version 2016, Part one, Chapter 3, Section 3. At: http://www.nordicplan.org/Commentary/Part-One/Chapter-3/Section-3/General/ (last accessed 25 June 2018).

[88] n 57 above, 64.

[89] The collision clause in many H&M policies appears to be the 3/4ths Collision Liability Clause. See Institute Time Clauses - Hulls 1.10.83, article 8. INTERNATIONAL HULL CLAUSES (01/11/03), article 6.

[90] n 57 above, 66.

objects, pollution, liability for obstruction and wreck removal, general average, salvage and others.[91] If P&I clubs were to accept the entry of unmanned/autonomous ships, it would still be necessary to consider whether or not the current P&I insurance would be adequate to cover the risks that may arise from the operation and navigation of such unmanned/autonomous ships. The paper thus discusses insurance for collision liability, cargo liability, pollution liability and salvage and general average liability.

1. Insurance for Collision Liability

Collision can mean two vessels coming into contact with each other, or certain non-contact damages caused by one vessel to another without actual contact.[92] Traditionally, the hull insurance covers 3/4ths of the damages caused by a collision incident;[93] in other words, the hull insurance underwriters agree to indemnify the assured for 3/4ths of any sum or sums paid by the assured to others in consequence of the insured vessel coming into collision with any other vessel.[94] For the extra collision liability, the assured can either agree on an optional additional clause with the hull underwriter under the INTERNATIONAL HULL CLAUSES (01/11/03),[95] or resort to the P&I Insurance. [96] In the latter case, the entered ship's P&I cover extends to indemnify the member in respect of the collision liability of 1/4th of the damages to (a) the other vessel, and (b) cargo and property on the other vessel as a consequence of a collision between the entered vessel and another vessel.[97]

There would not be much to call into question, provided the clubs were to accept the entry of an unmanned/autonomous ship, since the rules about collision liability insurance would apply equally to such a ship. Questions may however arise when an unmanned/autonomous ship that is not a member ship of any P&I club, were involved in a collision incident. Assuming the other colliding ship were a member ship of a P&I Club, then the foremost question to be solved is the identity of "unmanned/autonomous ship". As discussed above, there are not many hurdles to be overcome for unmanned/autonomous ships to fall within the definition of "ship" in the existing international legal framework; therefore, if the P&I clubs were to treat unmanned/autonomous ships the same as other ordinary ships, not much debate would emerge with regard to the collision liability between these two vessels. This would also be true if the collision incident occurs between two unmanned/autonomous ships. However, the situation would become complicated if the unmanned/autonomous ship in a collision incident is not admitted as a "ship", maybe even being illegal under certain domestic legislations. In general, P&I Clubs leave the question as to what is a "ship" or a "vessel" to general legal principles.[98] P&I insurance accepts the collision liability that may occur between his member ship and a structure, such as lighters and barges, landing stages

---

[91] For example, see Gard Rules 2016.

[92] n 61 above, para. 10.1.

[93] Shipowners insuring under American or Norwegian conditions, for example, may have full four-fourths cover. See ibid, para. 10.2.

[94] Institute Time Clauses - Hulls 1.10.83, article 8. INTERNATIONAL HULL CLAUSES (01/11/03), article 6.

[95] INTERNATIONAL HULL CLAUSES (01/11/03), article 38.

[96] n 61 above, para. 10.3.

[97] But only if and to the extent that such liabilities are not recoverable under the Collision Liability Clause contained in the hull policies of the insured vessel. See ibid, para. 10.2.

[98] ibid, para. 10.18.

and pontoons, floating "jack-up" platforms, and floating cranes.[99] Therefore, one may argue that if an unmanned/autonomous ship is deemed to be either a "ship" or a "structure", then the existing rules related to insurance for collision liability would likely apply.

With the further development of scientific and safety aspects related to unmanned/autonomous ships, one can reasonably expect that this kind of ship will become fully autonomous and smart. If such an ideal situation were reached, it could be possible that no collision liability insurance is necessary, since this kind of incident could well be prevented by the appropriate application of relevant software or computer procedures. Nevertheless, a collision incident could still occur as a result of software or manufacturing defects; in that case, cyber security insurance and product liability insurance, rather than marine liability insurance, should be in place.

2. Cargo Liability

Cargo claims may be brought when the cargo is lost, damaged or delayed. Cargo liability is incurred as a result of claims that are made against shipowners by cargo interests for loss of or damage to cargo.[100] Most of the P&I Clubs cover the liabilities, costs and expenses, to the cargo being carried in the entered vessel, resulting from the short delivery, unseaworthiness, improper stowage, and inadequate heating or ventilation that is caused by any breach by the member or by any person for whose acts, neglect or default causes the loss or damage.[101]

The club member is usually made up of shipowners, corporate and individual managing owners, ships' operators and charterers.[102] Such "other persons" usually include persons like: 1) the servants of the Member, e.g. the master and crew of the Ship; 2) ship managers or agents; and 3) independent contractors who carry out functions in relation to the ship and/or cargo, e.g. pilots, stevedores, mooring masters, harbour tugs or supercargoes. As already discussed, the operator of an unmanned/autonomous ship could be admitted either as the master or as an employee of the shipowner. It is thus arguable that cover would be available for any liability that the member has to indemnify the unmanned/autonomous ship operator in respect of liability incurred by him directly to the cargo interests, provided that the terms of the indemnity have previously been approved by the Club.[103]

The P&I cover is available on the basis that the member has acted as a prudent and responsible carrier. [104] Another issue that may thus cause controversy is related to the phrase "a prudent and responsible carrier". Will the unmanned/autonomous carrier be able to fulfil his obligation to act as "a prudent and responsible carrier"? A responsible carrier shall: (i) properly load, handle, stow, carry, keep, care for, discharge or deliver the cargo, and (ii) maintain the entered vessel's

---

[99] ibid, para. 10.19.

[100] ibid, para. 10.55.

[101] ibid, para 10.55.

[102] n 61 above, para. 6.10.

[103] ibid.

[104] For instance: Risks covered - Rule 34: Cargo liability, at: http://www.gard.no/web/publications/document/chapter?p_subdoc_id=20747996&p_document_id=20747880 (last accessed 25 June 2018).

seaworthiness and cargo worthiness. There are other more obligations depending on the liability rules that may apply in a particular case. If the carrier fails to maintain these obligations, the P&I Clubs may exclude the relevant cargo liability.[105] When considering the case of an unmanned/autonomous ship, issues arise such as whether or not the carrier is able to fulfil his obligation to take care of the cargo during the voyage if there is no crew or less crew on board. If we take the Hague/Visby Rules as an example, we see that according to these rules the carrier shall properly and carefully load, handle, stow, carry, keep, care for and discharge the goods being delivered.[106] This implies a continuous obligation on the carrier to take care of the goods carried "properly and carefully", running from the commencement of loading to the completion of discharge.[107] In the case of an unmanned/autonomous ship, the carrier may have practical difficulties in complying with this duty, since, for instance, how can the carrier conduct an immediate check-up on site if there is any breakage or leakage of the cargo?

With the further development of IT and big data, together with electronic bills of lading, and also the very new idea of blockchain technology,[108] it seems that all the data related to carriage of goods by sea will be updated on time and accessible to all interested parties. This being the case, then the certainty of transactions and business will increase. If every bit of information on the navigation and transportation is accessible using IT and autonomous technology, will cargo liability insurance replace cargo property insurance as a whole? This question is too difficult to answer at this stage. What we can forecast is that cargo property insurance will perhaps be less important as some of the cargo risks are progressively eliminated.

3. Pollution Liability

After several disastrous oil pollution accidents, coastal states have begun putting more pressure on shipowners and their insurers with regard to their potential pollution liability. A very significant example of this is the enactment of US OPA 90, which requires the shipowner to establish and maintain evidence of financial responsibility sufficient to meet the maximum amount of his vessel's pollution liability.[109] A series of international conventions are also in place on the subject of preventing and controlling vessel-source pollution.[110]

The impacts brought about by the introduction of unmanned/autonomous ships on pollution liability insurance is very much debatable. However, as long as an unmanned/autonomous ship can be deemed to be a "ship", there is not much cause for concern. One scholar has analysed that almost all the international conventions regarding vessel pollution protection would still be applicable, including the CLC 1992, the Fund Convention 1992 and the Supplementary Fund

---

[105] n 61 above, para. 12.55.

[106] Hague-Visby Rules, Art. 3. 2.

[107] Hague-Visby Rules, Art. 3. 2.

[108] M. English, S. Auer, J. Domingue, 'Block Chain Technologies & the Semantic Web: A Framework for symbiotic Development' (2016) *Computer Science Conference for University of Bonn Students* 48.

[109] 33 USC Ch. 40: OIL POLLUTION §2716. Financial responsibility.

[110] Currently, the international liability regime for marine pollution consists of three sets of conventions covering pollution incurring from the tanker oil, bunker oil and hazardous and noxious substances. L. Zhu, M. Z. Zhang, 'Insuring against Marine Pollution Liability: An International Perspective' (2015) 46.3 *Journal of Maritime Law and Commerce* 376.

Protocol, the HNS Convention, and the Bunkers Convention.[111] Nevertheless, issues will arise with regard to the prevention of pollution damage, which is closely related to issues of liability insurance, such as: How can the operator exercise due diligence to prevent or mitigate pollution hazards, damage or threat? How can one define "due diligence" in the case of unmanned/autonomous ships?

4. Salvage, General Average

As for salvage, rules established under the International Convention on Salvage 1989[112] and the Lloyd's Open Form of Salvage Agreement (1980, 1990, 1995, 2000 or 2011)[113] would still be applicable if an unmanned/autonomous ship were to be in danger. It is worth mentioning that in the International Convention on Salvage 1989, the vessel is defined as being "any ship or craft, or any structure capable of navigation"; thus it is arguable that unmanned/autonomous ships can fall within this definition and thus within the application scope of the Convention. The main issue here would be about the party that is entitled to sign salvage agreements and work with the salvors to prevent or minimize environmental damage. Very likely, the on/off-board vessel Operator (if not the owner himself) would be given the authority to do so on behalf of the owners and the cargo interests. Also, similar to existing practice, hull insurance and P&I insurance would bear the risks together: hull insurance covers the vessel's proportion of salvage and salvage charges, reduced in respect of any under-insurance; [114] and the P&I insurance covers the liability for special compensation awarded to a salvor.[115]

The adjustment of general average is normally made based upon the York-Antwerp Rules. The law and practice of the place where the adventure ends may also be applicable in some cases. Under the York-Antwerp Rules and some national laws, the decision made by the master shall be for the common safety for the purpose of preserving from peril the property involved in a common maritime adventure. Accordingly, this responsibility may be passed to the operator in the case of unmanned/autonomous ships.[116] The introduction of unmanned/autonomous ships may make the general average liability adjustment easier, for there would be no need to allow for the wages and maintenance of master, officers and crew reasonably incurred as general average.[117]

Accordingly, when liability insurance for salvage and/or general average is being considered, no big changes are envisaged with regard to the introduction of unmanned/autonomous ships.

---

[111] n 61 above, para. 25.9.

[112] An international conference in 1989 agreed a new salvage convention to profoundly change the previous convention of 1910.

[113] The Lloyd's Open Form of Salvage Agreement is the most widely used salvage contract, and is provided for English jurisdiction and London arbitration.

[114] The Institute Time Clauses - Hulls 1.10.83, Article 11. The INTERNATIONAL HULL CLAUSES (01/11/03), Article 8, which excludes the special compensation payable to a salvor under Article 14 of the International Convention on Salvage 1989, and expenses or liabilities incurred in respect of damage to the environment, or the threat of such damage, or as a consequence of the escape or release of pollutant substances from the vessel, or the threat of such escape or release.

[115] Gard Rules 2016, Article 42.

[116] E. Van Hooydonk, n 27 above. 422.

[117] The York-Antwerp Rules, Rule XI.

V. Conclusions

The introduction of unmanned/autonomous ships is quite extraordinary, and debates on many different aspects have started to flourish throughout both academic and industrial circles. This paper attempts to conduct a pioneering study on third-party liability insurance for unmanned/autonomous commercial ships. Since no authoritative definition has yet been given, the foremost issue concerns the identity of an unmanned/autonomous ship. So far, most of the research suggests that an unmanned/autonomous ship should be deemed to be a "ship", particularly under the existing international conventions.

Changes always bring about new risks. The most outstanding risks that could develop with the introduction of unmanned/autonomous ships are: 1) The safety of software maintenance and reliability of its manufacture; and 2) the risks related to piracy and cyberattacks. However, it is clear that these two risks are not unique to maritime adventure, and the roles played by product liability insurance and cybersecurity insurance for unmanned/autonomous ships may eventually increase. P&I clubs are the main insurance provider for shipowner's third-party liability and, interestingly, it is proven in this paper that as long as the P&I clubs accept the entry of unmanned/autonomous ships, there would not be much change needed with regard to third-party liability insurance. Having said that, there are also many new concerns, such as how to coordinate and harmonize the relationship between P&I insurance and product liability insurance or cyberattack insurance.