1 www.rolls-royce.com/media/press-releases/yr-2016/21-06-2016-rr-publishes-vision-of-the-future-of-remote-and-autonomous-shipping.aspx
2 For reasons that will become apparent, the use of "craft" is an industry shorthand used here to assist analytical expression and is not intended to have any legal connotations.
3 Other unmanned craft are, in fact, pre-programmed to manoeuvre autonomously without any human interaction, using control algorithms. For larger scale unmanned craft, at least initially, however, these will no doubt be remote controlled.
4 UNCLOS, article 91.
5 Merchant Shipping Act 1995, section 313.
6 For instance, *The Mac* (1882) LR 7 PD 126; *The Harlow* (1922) 10 Ll L Rep 66; [1922] P 175; *The Mudlark* [1911] P 116; *Wells v Owners of the Gas Float Whitton (No 2)* [1897] AC 337.
7 UNCLOS, article 94(4)(a).
8 Merchant Shipping Act 1995, section 313.
9 IMO Resolution A.1047(27) Principles of Minimum Sage Manning, Annex 1.
10 *The Murdoch* [1953] 2 Lloyd's Rep 433.
11 *The Nordic Ferry* [1991] 2 Lloyd's Rep 591.
12 Ibid.
13 See the efforts of the UK's Marine Autonomous Systems Regulatory Working Group, in particular, "Being a Responsible Industry, An Industry Code of Conduct for Marine Autonomous Systems", UK Marine Industries Alliance, 2015.

Objective and subjective safety in unmanned shipping

Unmanned ships must be as safe as possible to ensure that they are adopted and operate successfully. To objectively consider unmanned ships safe, appropriate laws must apply, and, in order to ensure that they do, definitions of autonomy have to be agreed upon between lawyers and engineers. An example of ensuring subjective safety is to ensure that collision avoidance systems fully incorporate Collision Regulations.

Introduction

As is often asserted, unmanned ships, which are ships without a master and crew onboard, are the future of shipping, and that future is rapidly approaching.[1] This is largely due to the potential cost savings from not having to pay people to be onboard, and the reduction of human error. However, the law is a crucial factor in determining whether unmanned ships are feasible: whether they can be a commercial reality and not just a technological possibility.

This article will consider two ways of ensuring the safety and feasibility of unmanned ships. The first concerns objective safety, which means ensuring that appropriate laws apply to unmanned ships. The second concerns subjective safety, which relates to how other users of the seas will perceive and interact with an unmanned ship. Both types of safety are needed, and the relevant laws and regulations must be tested against available technological solutions.[2]

Objective safety: defining autonomy

When referring to unmanned or autonomous ships it can be unclear what is meant by autonomy, yet it is an important concept in defining the legal position of the ship and the owner. If the ship itself is considered as the equivalent of the master this leads to issues of conferring legal personhood on an unmanned ship. The law could go even further and consider it as a human, because if the machine can perceive, understand and make decisions like a human it could be treated as such.[3]

If legal personhood was applied to unmanned ships, liability would still be imposed on the owner, so it would be an unnecessary distinction from other ships. Treating the ship (or at least its intelligent systems within) as human would not be effective, as the owner would not be held liable and suffer losses to motivate change. A less complicated way of considering autonomy of an unmanned ship is as the autonomy of a possession, for which the owner is responsible. Therefore, the law would apply to the ship and owner as it does now.

Yet there may be occasions when distinctions are needed between the different types of ships and to develop these definitions will require the aid of engineering. For instance, the imposition of some or all of the liability for an autonomous ship could be on the programmer, whereas on a remote-controlled ship it could be on the remote-controller. This is complicated by there not being a single definition of autonomy in engineering, as definitions tend to refer to the different systems and technical features that may be involved.

Therefore, between law and engineering there is a need for definitions for the varying degrees of autonomy. This will allow definitions for fully remote-controlled, fully autonomous ships, and ships that can switch between autonomous and remote-control modes, to reflect and classify the different levels of control. Although these definitions would not seek to absolve the owner of liability, it may be important for the owner trying to recover damages from the company that programmed the unmanned ship, or from the remote-controller acting beyond the scope of his employment.

One definition that could be used is from the International Organization for Standardization, which defines robot autonomy as "the ability to perform intended tasks based on current state and sensing, without human intervention."[4] This definition does not have too much technical detail, so should be broad enough for legal purposes, but it still may need variants for remote-controlled aspects, as being capable of operating without human intervention does not mean there will not be intervention (eg as a fail-safe).

Some unmanned ships could be considered as semi-autonomous, as they are "supervised by humans and can if necessary be corrected and overridden" by humans.[5] For instance, sensors could cause a change in the operating mode throughout the voyage. Yet until there is legal authority for any of the definitions it is mere speculation. These wide definitions, it is argued, are the best to use for the law (eg the definition of "ship"). In relation to autonomous underwater vehicles, a code of practice introduced definitions, but they would include the purposes they were used for as well as operational aspects (powering, control, methods of communication).[6] As operational aspects may vary between types of unmanned ships, it is important that the definitions are not too narrow, especially to account for changes in operational aspects over time. Yet definitions for those three categories are still needed, which could be provided by the attempts mentioned above.[7]

Lawyers and engineers need to be able to understand each other using agreed upon definitions, which is important for ensuring the safety of the systems for the ships themselves and other users of the seas, as the "interaction between manned and unmanned vessels is likely to be a major point of risk."[8] Incidents involving different kinds of autonomous ships may apportion liability to different people, so this clarity will ensure that they take measures to ensure the ship is safe.

Subjective safety: collision avoidance

It is important that unmanned ships are as safe as current ships as well as being bound by the same regulations.[9] This is necessary, as users of the seas would not want safety, which has improved over years, to be lower on unmanned ships that they may encounter, increasing the risk of an incident that affects them.

Unmanned ships do provide a way of addressing some safety concerns by avoiding human error onboard (and thus could avoid the situation that caused the incident of *Costa Concordia* where the Captain deviated from a safe route without cause); the risk of some human error remains, as the pre-programmer or remote-controller may make an error. However, other potential threats to safety also need to be addressed, which include avoiding collisions with other users of the seas.

Therefore, it must be considered whether the International Regulations for Preventing Collisions at Sea 1972 (COLREGS) can be implemented on an unmanned ship as well as they can on a manned ship. COLREGS has been oversimplified in some collision avoidance systems, so that the navigation, detection and reaction algorithms are not fully developed.[10] Systems can be referred to as simply taking collision (or navigational) rules into account, meaning the systems ignore the details of the regulations.[11]

Collision avoidance systems merely require that the collision is avoided to be considered as COLREGS compliant.[12] Yet COLREGS is not just the absence of collision, but rules of navigation and signalling. Also, the collision has to be avoided in the right way, eg Rule 9: passing port to port, which allows each ship to predict how the other will act and reduce risk.

COLREGS' purpose is to aid ships to avoid collisions by following traffic separation schemes and having navigational rules. It has been admitted that a lot of systems do not include programming on narrow channels and the applicable rules.[13] Without doing so, manned and unmanned ships will not be following the same rules and will appear to be acting in unpredictable ways that increase the risk of collision. Therefore, in order to ensure that these systems are safe, mapping software with response codes for the behaviour of other ships should be included as part of collision avoidance systems. Combining these features would be easy, but can be overlooked when collision avoidance systems are being developed.

There is also the lack of accounting for choice. The ability to choose between types of damage: those suffered by the ship; damage to other ships and those on them; or environmental damage.[14] This presents an ethical and moral choice that would require very careful programming on an autonomous ship and potentially the use of artificial intelligence. The decision would have to be justifiable, as the decision maker (whoever that will be considered to be) will be held to account in law and in the public conscience. Thus, further research is needed into how these decisions will be made, recorded, and understood.

Collision avoidance systems also do not take into account that other ships may disregard COLREGS, or simply not act soon enough, or when the actions of the other ship are not enough.[15] Not considering one or even more ships acting with such disregard could result in the system not understanding the situation and the possible consequences of manoeuvres, and either giving the wrong response or none at all.

In some collision avoidance systems it is assumed that there are no regulations governing the behaviour of the unmanned ship or other ships it may encounter, yet this removes an important method of perceiving and predicting behaviour.[16] Therefore, it is more reasonable to assume that COLREGS apply, so that the unmanned ship acts as it is expected to act, and can react with understanding to other ships (with provision that those ships may not act as expected and thus alternative actions may be required).

The purpose of COLREGS is to make navigation safer. When there is a crew and the navigator is incapacitated there is someone else who knows the rules and will ensure COLREGS are complied with and hopefully ensure the voyage is safe and does not cause harm (see the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978).[17] When the system fails there will need to be redundancy systems. Collision avoidance is not about one potential incident being avoided, but about reducing the risk in advance by following navigational rules. It is important to consider, when developing the systems, what back-up options are available: whether it is shore-based navigation, or another fail-safe system that is triggered. It is suggested that when developing collision avoidance systems these options are considered to ensure that they function well together, instead of risking an incident by the fail-safe not being triggered, as part of one bigger system of collision avoidance and not in isolation.

Many aspects of collision regulation are starting to be integrated into autonomous operational safety, but one which is not is one of the most important provisions of COLREGS: the duty of good seamanship in Rule 2. Perhaps it is understandable that the systems have not tried to address the duty of good seamanship, as it is a broad undefined duty. Thus it presents a greater challenge to program. Yet fuller programming of COLREGS, including the ability to choose between collisions and damage, and ability to judge when it is necessary to depart from the rules, may address this. By lawyers and engineers creating a dialogue about these issues the systems will be more holistic, intelligent, and safer.

As part of this dialogue, issues of potential liability may be addressed (a wider discussion of which is beyond the scope of this article). If it can be argued that the remote-controller can discharge the duty, or that the ship as an autonomous machine can be equivalent to a seaman and discharge the duty, then liability can still be channelled to the owner.

Conclusion

Improving COLREGS compliance and defining autonomy are important starting points for ensuring safety on unmanned ships. In defining autonomy, the law would be defining where unmanned ships are in the scheme of maritime law – it would clarify their position as ships and the law with which they need to be able to comply. By increasing the ability of systems to comply with COLREGS safety will be improved when interacting with other ships, both unmanned and manned, and other navigational challenges. These initial steps of subjective and objective safety are the first of many that need to be taken, as there are many more issues of applicability and definition, as well as the ability to comply. Each challenge will have to be approached with a desire to ensure clear applicability of existing or new laws, and a desire to make the systems capable of reaching high standards of safety.

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[6] Dering (ed), *The operation of autonomous underwater vehicles volume one: recommended code of practice* (The Society for Underwater Technology, 2000), page 12.
[7] Floreano (footnote 4), page 262; Van Hooydonk (footnote 5), page 404.
[8] "Autonomous ships: what is the future?" (*Maritime Risk International*, November 2015, page 6).
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[11] Shi, Zhang and Peng, "Harmonic potential field method for autonomous ship navigation" (7th International Conference on ITS, France, 6 to 8 June 2007), page 1.
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[13] Shi (footnote 11), pages 4 to 5.
[14] Xue, Lee, and Han, "Automatic collision avoidance of ships" (2009) 223(1) Journal of Engineering for the Maritime Environment 33, page 45.
[15] Praczyk, "Neural anti-collision system for autonomous surface vehicle" (2015) 149 Neurocomputing 559, page 560.
[16] Ibid.
[17] Rødseth (footnote 9), pages 6 to 7.

Case update

Charterparty hire payment terms

Spar Shipping AS v Grand China Logistics Holding (Group) Co Ltd (The "Spar Capella", "Spar Vega" and "Spar Draco") **[2016] EWCA Civ 982**

The facts

Under three charterparties dated 5 March 2010 on an amended NYPE 93 form, the respondent Spar Shipping AS (the registered owner) agreed to charter three supramax bulk carriers to Grand China Shipping (Hong Kong) Co Ltd ("GCS") (the charterers) for very long charter durations. The charterparties provided for guarantees to be issued by the appellant Grand China Logistics Holding (Group) Co Ltd ("GCL"), the parent company of GCS. Three letters of guarantee were issued on behalf of GCL on 25 March 2010.

The charterparties were on identical terms, save as to the rate of hire, period, delivery laycan and vessel details. The withdrawal clause, including an anti-technicality clause, was in the same terms in each of the charterparties and mainly identical to the standard terms of clause 11 of the NYPE 93 form.

From April 2011 GCS was in arrears in payment of hire. Spar recouped some of the arrears by exercising its lien on sub-freights, but there remained substantial arrears of hire on all three vessels throughout the summer of 2011 and a chronology of missed or delayed payments. Spar called on GCL for payment under the guarantees on 16 September 2011. On 23 September 2011 Spar withdrew one of the three vessels and terminated that charterparty. On 30 September 2011 Spar withdrew the other two vessels and terminated those charterparties.

Spar commenced arbitration proceedings against GCS, claiming the balance of hire due under the charterparties and damages for loss of bargain in respect of the unexpired term of the charterparties. Shortly prior to the arbitration hearing, GCS went into liquidation in Hong Kong and the arbitration proceedings were stayed. Thereafter, Spar commenced court proceedings against GCL under the guarantees.

At first instance, Popplewell J held that payment of hire by GCS in accordance with clause 11 of the charterparties was not a condition but concluded that GCS had renounced the charterparties at the date of the termination notices, which were to be treated as an election to terminate the charters preserving Spar's common law right to damages for loss of bargain arising out of such termination. (For detailed discussions on this, see Liu, *Shipping & Trade Law*, (2015) 15 STL 4 5).

GCL then appealed to the Court of Appeal, contending that the judge had erred in holding that GCS had renounced the charterparties. Spar submitted that the judge was right on the renunciation issue but argued that the judge erred in failing to hold that payment of hire was a condition.

The law

The condition issue

This issue, as Gross LJ observed, was concerned with the controversy as to whether the obligation to make punctual payment of hire was or was not a condition in standard form time charterparties, subject to any specific express wording not found in the charterparties. A condition was a term any breach of which was sufficient to entitle the innocent party to terminate the contract and claim damages for loss of bargain. If, as the trial judge had held, the obligation in question was not a condition, then GCS's failure to make punctual payments of hire entitled Spar to terminate the charterparties pursuant to the express provisions of the withdrawal clause in clause 11 thereof – so putting to an end future performance obligations and also to claim the