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Will the smart ship also be the liable ship?: An analysis of the application of liability to the ship itself

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WILL THE SMART SHIP ALSO BE THE LIABLE SHIP?: AN ANALYSIS OF THE APPLICATION OF LIABILITY TO THE SHIP ITSELF

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SUMMARY

As engineers develop the future of shipping: unmanned ships, and autonomous operating systems, which do not need a master or crew on-board, it is asked: 'who shall be held responsible?' Research into autonomous systems has considered holding the owner, the manufacturer or programmer responsible by considering the autonomous system as their instrument. Another suggestion is to make the ship liable.

The problem is that the idea of the system itself being held liable has not been considered in relation to shipping. It is concluded that it would not be possible to hold the ship liable in international maritime law. Previous research found that it is problematic to impose remedial measures on a system; additionally, in maritime law the system is based on the owner being liable and minimal change being required is needed to ease the introduction of unmanned ships. Therefore, liability will not be imposed on the ships themselves.

1. INTRODUCTION

Unmanned ships are the next big revolution in the shipping industry, but how they operate will vary greatly. The aim is for them to operate without a master or crew on-board. This could be achieved through smart systems, such as remote-control, or autonomy. Therefore, it is without a doubt that an unmanned ship will be a smart ship (as will manned ships that combine these systems with crew on-board).

However, what is in doubt is whether changing how a ship is controlled, and operated, will change the liability system. Therefore, this paper will explore the entities involved in the operation of an unmanned ship that could be held liable. The current liability laws will also be explained, and it will be discussed whether the current system will be appropriate. Then alternative systems of imposing liability will also be considered, importantly including whether the ship itself can be held liable. This builds on the current research on models of liability by applying them to smart shipping. This will include a discussion of the challenges of imposing remedial measures on a ship.

2. ROLES OF PEOPLE AND SYSTEMS

Although smart ships are considered to be unmanned they may still be manned, and the systems complement the role of the crew. Smart ships will vary in manning, and in how their control systems operate (see figure 1). Therefore, smart shipping does not mean the instant and utter end of seafaring: some ships may need to be manned, but will make use of the technology, and other ships may represent a phased introduction of smart technology (especially during the early stages, until reliability and trustworthiness are established).

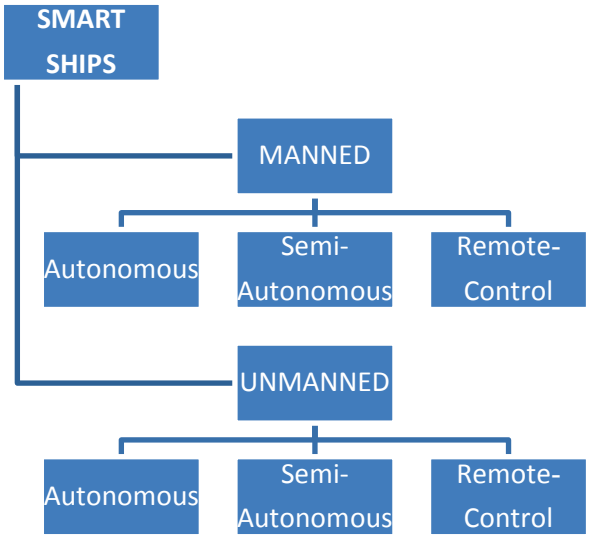

Figure 1: showing that both manned and unmanned ships could use similar smart technology to operate.

2.1 PEOPLE AND SYSTEMS ON UNMANNED SHIPS

On unmanned ships the ship will operate either autonomously or through remote-control, or a combination of the two. The main human involvement with unmanned ships is during the creation of the ship (even more so when autonomously controlled) to ensure that the smart technology is capable and reliable. However, humans will be more directly involved when remote-control is used. There will be greater reliance on the smart technology on an unmanned smart ship than on a manned smart ship.

2.2 PEOPLE AND SYSTEMS ON MANNED SHIPS

Manned ships could be autonomous for large parts of a voyage. For example, autonomous mode could be used when performing deep sea shipping then the crew could take control when near the coast or in busy shipping lanes. In the Maritime Unmanned Navigation through Intelligence in Networks project it was suggested that the ship could be unmanned when in the deep sea, but a pilotage crew come on-board when approaching the coast and return manned control [1]. The same approach could be taken, but instead of getting them on-board they are waiting on-board. This would be especially useful and more cost-effective for ships that are in port frequently.

Manned ships could utilise the technology from remote-control systems, so instead of a simulated bridge in a shore control centre the additional data could be presented on the bridge to complement what the crew can perceive for themselves. Although this would not be as remote as one envisages when discussing these systems. This would not be that different from current data reception and control from the bridge, the main differences would relate to the data received and the lack of manual tasks elsewhere on the ships (they would only work on the bridge). However, there could be the ability for them to retake control as part of a redundancy system. There is also the option to transfer between remote-control, and autonomous systems, and thus reduce their role further. This could be a way of phasing in the introduction of remote-control and autonomous systems.

Therefore, there are many roles that a crew can perform on-board a ship even with smart technology:

- Normal crewing assisted by smart technology,
- Remote-controllers from the bridge,
- Supervision when in autonomous mode,
- Authorising certain actions, while others are carried out autonomously,
- Pilotage (e.g. when near the coast), and retaking control when circumstances dictate.

2.3 REMOTE-CONTROLLERS

When remote-control is utilised on a manned smart ship it is clear that the remote-controllers would be considered as comprising the master and crew. However, with an unmanned smart ship this is not as clear. In order to ensure the applicability of maritime law, without having to make a lot of amendments, which is considered by many lawyers to be essential to the successful introduction of unmanned ships, remote-controllers need to be considered as the master and crew on-shore [2].

If they were not, this would involve the creation of new regulations to govern them, and although they could do so and borrow provisions from existing maritime law, this would take longer and may delay the introduction of unmanned smart ships. Arguably there are benefits from this delay: for example, the reliability of the technology can be demonstrated for longer on manned ships and other vehicles; and allow seafarers longer to adapt and retrain.

However, this writer is not convinced that these are substantial benefits, as training will begin when smart technology becomes more prominent on manned ships, and there will be willingness from seafarers to train to ensure employability. Additionally, the shipping industry is famously slow to develop in this field, thus the technology will be shown to be effective through other industries, and the shipping industry will not introduce smart shipping until it is satisfied with its ability (the risk cannot be too high, as manning has become less of a prevalent cost).

Therefore, the simplest solution is to interpret the master and crew as capable of being on shore. If necessary this could be reaffirmed through a convention that will state that for unmanned ships the remote-controllers will be the crew, with the manager (or chief controller) as the master. In turn these personnel (who are likely to be ex-seafarers) can be required to have the same training as a seafarer with the addition of remote-controller training.

3. LIABILITY IN MARITIME LAW

Maritime law is a specialist area of the law, and, as already been discussed, poses unique challenges. Maritime law is comprised of international and national law. International law comprises of conventions and customary international law. Primarily, this paper focuses on international maritime conventions, which often comprise of five defining features:

- Channelling liability to the shipowner,
- Strict liability,
- Limited liability,
- Compulsory insurance,
- Direct action against the insurer.

These features allow for third parties to receive compensation for damage as easily as possible. These conventions can be complemented by the provision of central funds (for instance, in relation to oil pollution there is the International Convention on Civil Liability for Oil Pollution Damage 1992 Protocol, as amended (CLC), and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage 1992 Protocol, as amended (FUND)).

The conventions themselves place liability on the shipowner. Although through insurance, or compulsory insurance and direct action against the insurer, for larger ships, the insurer pays. Therefore, the shipowner has the responsibility to pay their premium or call, abide by the provisions of their insurance, and minimise the risk of incident. The master can be important for the channelling of liability to the shipowner, as the master represents the

shipowner on-board. A master can also be personally liable.

International maritime law usually involves civil liability, but some conventions when violated also create criminal liability (e.g. International Convention for the Safety of Life at Sea 1974, as amended), for which the remedy is monetary.

However, this model of liability is not necessarily the best model for such a revolutionary change in shipping. Especially since smart shipping will eventually involve artificial intelligence and autonomy. A separate convention for smart ships will not be considered in this paper, but whether the law can be interpreted to impose liability differently than it does now.

4. LIABILITY OPTIONS

As Susan Lanoue said, "the potential for human injury due to a malfunctioning computer program is tremendous. No longer can computer-caused injuries be relegated to the realm of futuristic science-fiction novels" [3]. However, it is not just human injury that can be caused, there could be property damage or economic loss too [4]. Therefore, it is important that there is an effective liability system that imposes sufficient liability on the appropriate party.

Table 1: showing who could be held liable under each liability model. Numerous people could be held liable under each model or between models if an incident occurred.

Liability model	**Who could be liable?**
Perpetration-via-another	Programmer Manufacturer Owner Operator
Natural-probable-consequence	Programmer Manufacturer Owner Operator
Direct	Artificial intelligence entity

Gabriel Hallevy has been a strong proponent of exploring different liability models in relation to artificial intelligence. He explored three models of liability:

- The perpetration-via-another liability model;
- The natural-probable-consequence liability model;
- The direct liability model [5].

Hallevy has focused his discussions on criminal liability, but this paper will discuss the models in relation to civil liability as well. The first two models consider liability for the maker (programmer/manufacturer), or the user (owner/operator), whereas the third model imposes liability on the artificial intelligence entity itself (see table 1). If applied to the owner, the first two models could apply the law as it is, but justified differently. Hallevy considers these models as applicable to unmanned vehicles, which in future will include smart ships [6].

4.1 PERPETRATION-VIA-ANOTHER

Hallevy's perpetration-via-another model considers the artificial intelligence entity as an innocent agent, which although highly developed is still just a machine [5]. Therefore, the entity is not considered capable of the commission of the offence, and is the instrument of either the maker (as they design the entity to commit the act), or user (as they instruct them to commit the act) [5]. However, this model is not appropriate if the entity decides for itself to commit the offence [5].

4.2 NATURAL-PROBABLE-CONSEQUENCE

Hallevy's natural-probable-consequence model is also based on the involvement of the maker or user, but not them intending the offence (as under the perpetration-via-another model) [5]. This model is based on whether they could have foreseen the commission of the offence, and thus whether they were liable in not preventing it [5]. For instance, as an expert a programmer would be held to the standard of the reasonable programmer [7].

4.3 DIRECT LIABILITY

Hallevy's direct liability model is based on no human having involvement in the commission of the offence [5]. A human is not found to have a mental state for the completion of the offence [5]. Thus, the entity is considered as tantamount to a human (i.e. a legal person) [5]. As unmanned ships are developing to the point that they can perceive the environment themselves this model is appropriate. Having the ability to understand what they perceive, and interpret it, is equivalent to a human [6]. Therefore, it is important that by applying direct liability that a ship will be treated as having legal personhood [6].

David Vladeck considers legal personhood to be dependent on the development of full autonomy, and considered there to be no reason for them not to have legal personhood [8]. Vladeck summarises this as "they will not be tools *used* by humans; they will be machines *deployed* by humans…" [8]. It is thought that their ability to perceive and decide like humans will allow them to behave like humans, and perform to a higher standard without distractions [8].

However, there are many challenges posed by direct liability, which will be further explored later. These challenges include imposing remedies, insurance, and the nature of maritime law.

4.4 STRICT PRODUCT LIABILITY

Another option has been explored by other writers, including Lanoue, which is to apply strict product liability [3]. Lanoue recognises that a benefit of strict product liability lies in not having to prove negligence (or intent) [3]. It is based on a defect in the product, and although there has been discussion as to whether such control systems are products or services, it appears as though they are products; most doubt focuses on when they are custom-made, as they may be for larger ships [3].

Strict product liability is usually justified as providing reassurance for products that pose an additional risk [9]. This seems counter-intuitive when smart shipping supposedly represents safer shipping. However, new risks are considered to be riskier than risks that people are familiar with. Therefore, as a user the guarantee of compensation for a smart ship from the manufacturer may encourage the user to change from conventional ships to smart ships. In fact, the risk is smaller, yet the unknown creates the perception of greater risk. The same can be seen throughout the insurance industry, for instance when the flood risk is unpredictable it results in higher premiums [10]. Thus, strict product liability can be considered appropriate for smart ships which will increase safety. Additionally, this will be a small burden on manufacturers, because although they will be liable there will not be as many incidents for which they will have to pay.

Strict product liability is likely to place liability on the maker (manufacturer/programmer) instead of the owner, as it is based on the product being defective. Vladeck proposes that strict liability in relation to such smart machines/systems would not be based on the fact that vehicles are highly risky, but due to the reduced risk so that any incident is deserving of liability [8]. Strict product liability gives users confidence to accept the risk, even though it is a small risk [3],[9].

Whether strict product liability is justified by the greater perception of risk, or the reduced risk of incident it can be justified. However, the greater perception of risk is a justification that is more concurrent with current justifications.

There are many benefits to strict liability, including the ability to deter faults that could result in liability, and improve standards [3]. However, there is some doubt as to whether this can be achieved in machines that are controlled by computer systems, which are more intelligent and designed to be safer [9].

Unfortunately, intelligent systems such as computers develop ‘bugs’ easily, which could mean a lot of liability and could deter the industry developing. However, Lanoue notes that the common nature of faults has not been a problem for computer system manufacturers, so other companies may not be deterred [3]. Also, if it gets to the stage that these smart ships are safer than current ships, strict product liability will not cause as much of a financial burden.

Lanoue notes that it would not be suitable if the law allowed, in relation to cars, a strict product liability claim for a steering mechanism but did not if that steering mechanism was defective due to a computer program [3]. This argument focuses on ensuring equality between claimants in law. In maritime law, a lot of liability is fault based, but there is also limited strict liability, and all liability is channelled to the shipowner. Therefore, it could be argued that although strict product liability is an appealing option, it would introduce different liability systems based on how smart the ship is.

Strict product liability would also not preclude the maker, or their insurer, from recovering later from any persons that contribute [8].

4.5 COMBINING MODELS OF LIABILITY

It is possible that using one of Hallevy’s models could find both the maker and user liable, or using a combination of the direct liability model and one of the others that the system could be held liable along with the maker and/or user (especially if there is complicity between the actors). Hallevy asserts that the direct liability model can apply independently, so the entity alone can be liable [5].

Additionally, the mode by which the manufacturer, user, or ship is found liable could be strict product liability. Although it is more likely to be the manufacturer who is held strictly liable. It would not be justified as it is under Hallevy’s models. However, it would be the same result. Then they could try to pursue the user, or even the ship for their contribution (applying Hallevy’s models). This would allow the channelling of liability that aids claimants, which is favoured in maritime law.

As Vladeck notes, if humans are still involved in decision making then the liability rules will be the same [8]. Therefore, if either the perpetration-via-another liability model, or the natural-probable-consequence liability model, the law will apply to humans and corporations as it does now.

It is also possible that all parties could be held liable, along with the ship itself (see figure 2). However, it seems redundant to hold the owner liable as well as the ship. Although the action of the ship may be utterly unforeseen and out of the control of the owner, if a ship is owned it will be effectively being holding the owner liable by two methods. The ship is not independent, and will depend on the resources of the owner (e.g. maintenance and finance) – there will still be a company for the ship, so holding the ship liable would be akin to holding the shipowner liable. Each ship will be

independent, as ships are now through one ship companies, so this would not be remedied and increase sister ship arrest.

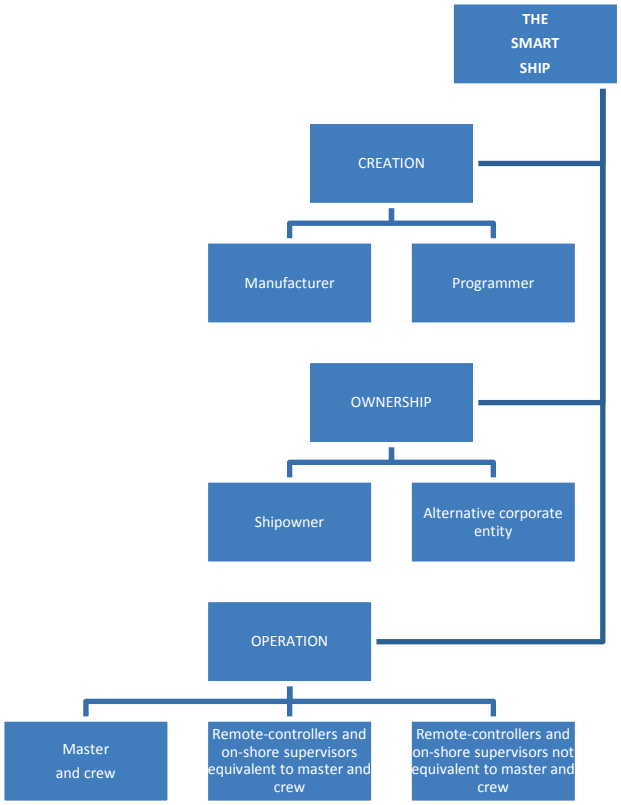

Figure 2: showing the parties in the aspects creation, ownership, and operation of a ship, and thus indicating that there are many different parties who could be held liable if there is an incident with a smart ship.

Therefore, it is possible that many could be held liable for an incident (most likely through a series of cases). This is why it is beneficial to channel liability. The issue then becomes who is it best to channel liability to: the manufacturer, the shipowner, or the ship?

4.6 WHY FIND THE SHIP LIABLE

As previously discussed, there are benefits to channelling and imposing liability on each of the parties, but this paper will now focus in more detail on the potential liability of the ship.

The arguments that favour holding the ship liable focus on the autonomy of the ship mean that the ship must be held to account and responsible by the law. For this to be effective, the ship would have to be programmed to understand the law, responsibility, and justice, and respect the law so that it complies with the law. This programming could mean that violations of the law are fewer than with seafarers, shipowners, and remote-controllers, who do not necessarily know the law as well (especially with the passage of time and forgetfulness); who could be more inclined to think that they are not breaking the law when acting under another motivation; or willing to disregard it. For example, a system can follow the rules of navigation in the Convention on the International regulations for Preventing Collisions at Seas 1972 and not incorrectly perceive a situation through a 'trick of the eye' and then make the wrong manoeuvre resulting in damage. Initially this programming could be ideal for ensuring the effectiveness of the law.

However, through time, the autonomous system will learn, and may determine that violating the law is more beneficial (especially if economical, or cost-effective, disregarding the cost of liability). This could be prevented by programming the ship with limitations that will not allow violations of the law, unless it is absolutely necessary and not for the selfish gain of the ship (as in *The Saint Jaques II* [2002] EWHC 2452, [2003] 1 LLR 203).

An autonomous ship will need to be programmed with these limitations to ensure that its learning is legally compliant. There will still be a role for the courts because if there is an incident, and the investigation finds that the decision of the ship was not clearly correct the data recorded will have to be presented to the court to determine liability (which will then require the legally compliant programming in that ship and others to be updated). These cases will also occur due to the fact that law is not always clear, and often intended to leave some flexibility, which leads to ambiguity.

5. HOLDING A SHIP LIABLE

As previously mentioned, there are many reasons for imposing liability on the smart ship. Most of these reasons depend on the autonomy of the smart ship. Thus, not all ships, and not all smart ships should be held liable: only autonomous smart ships. Other smart ships would require the application of current maritime law, or the law to be applied using one of the other models discussed in this paper (as in the section that discusses smart ships that utilise remote-control).

However, there are still practical problems with imposing liability on a smart ship, even if theoretically autonomy can justify liability and legal personhood can impose that liability.

5.1 DEFENCES

Hallevy, in relation to criminal law, asked whether a system that is malfunctioning, and its capabilities corrupted into making the wrong decision, can use the defence of insanity [5]. It can also be asked whether the system can suffer a loss of control [5].

Hallevy also asks whether the infancy defence would apply to systems, as they can develop an understanding of right and wrong [11]. This would be further supported when a system has not been programmed to understand the role of the law, and respect it. However, this programming would be there throughout its life, so this understanding would not be developed in the same way as in a human. Though it could still develop through the exposure of the system to the world and the knowledge it acquires. The problems with this are supported by the fact that corporations that have legal personhood, are unable to use a defence equivalent of infancy.

Hallevy also considers whether a virus infecting the operating system would be the equivalent to the influence of intoxication [11].

The important consideration to make here is that legal personhood is being suggested for the ship, which is more likely to be akin to the liability of a corporations and not a human. These defences are not available to corporations, and thus are unlikely to be available to a ship. Although they do raise interesting ethical and theoretical points making these defences available to the ship would not be practical.

5.2 REMEDIAL MEASURES

Punishments ranging from the death penalty, to imprisonment, to probation, and to fines are problematic when imposed on a system, so it may need to be asked whether other remedial measures will need to be developed instead [11]. For instance, corporations are held liable for any criminal offence that has a monetary penalty (though individuals in the corporation in certain circumstance will be personally liable).

5.2 (a) Capital punishment

Capital punishment is an effective measure for preventing an actor from committing further offences [5]. The same would apply in relation to a ship, if the whole ship or that control system was taken out of commission. However, this would not have one of the principle justifications of capital punishment, because it would deter another ship from committing an offence as it does not have a life to lose.

5.2 (b) Imprisonment

Hallevy considers imprisonment of an entity would prevent the entity from committing further offences for the specified period [5]. The inability to operate is tantamount to depriving the entity of freedom [5]. However, can a ship be considered as having freedom or liberty? Even with artificial intelligence, the ship would be made to work and would not have the freedom to do things other than work.

5.2 (c) Community service

Hallevy argues that the entity can be used for community service, as it will often be used for private benefit and it could be made to work for public benefit instead [5]. Doing work, other than what it is programmed to, is not a punishment: the reason for a voyage is not relevant, simply that it is on a voyage.

5.2 (d) Fines

Monetary penalties are also popular remedial measures, and of particular relevance to shipping. One method would be to take property, which could be the ship itself. Hallevy argues that since it is possible to fine a corporation that it is possible to fine a legal person (in criminal and civil law) [5]. As like a corporation it is still run by people, it represents an accumulation of people (wealth, knowledge, freedom to accept certain voyages), and becomes more than them. It develops its own wealth through voyages, as a corporation does through business [11].

However, currently, a ship is owned by a corporation – it is an asset of company, not the company itself. Thus, it would require a different understanding of a shipping company than is currently used. If this were possible, then the effect of the monetary penalty would be the same as it is now on the shipping company and its insurer.

5.3 MARITIME REMEDIAL MEASURES

5.3 (a) Arrest

Remedies and measures taken in maritime law specifically need to be considered in more detail now. Arrest of a ship is a form of obtaining security against the shipowner for a claim.

Arresting is considered to be problematic to Hallevy when there is not a physical body, but a ship does have a physical body to arrest [11]. However, there would be a physical ship to arrest, so this would solve Hallevy's problem.

The arrest of the ship could also serve to reinvigorate arguments regarding the fiction of personhood for *in rem* arrest of the ship in maritime law. It would make sense that the ship will be held to account, as the ship is its own owner, it is the shipowning corporation, it is responsible for the fault instead of the shipowner (as a separate entity) under the law currently (*in personam* arrest).

In American law, the fiction of personification still exists for *in rem* arrest, and Michal Chwedczuk recognises the impact that unmanned shipping can have on *in rem* arrest in America [12]. Chwedczuk hopes that despite the

ability that unmanned shipping has to support the fiction that it will not and instead American arrest law will become as it is elsewhere (i.e. no longer apply the fiction of personification) [12].

However, the worrying aspect of unmanned or smart shipping is that it could reinforce it in America and resurrect the fiction elsewhere to the point that it is not an isolated fiction, but a greater fiction of maritime law. It could also lead to conferring legal personhood on the ship.

5.3 (b) Compensation from the shipowner

Another aspect of maritime law is obtaining compensation for any damage caused by a ship. The shipowner is the first source of compensation in maritime law, and liability is channelled to the shipowner in order to make it easier for claimants to get compensation. Although the money itself is likely to be from the insurer, it is still easier to make all claims to the shipowner and they can try to recover from other parties.

This could work for a ship as well, the ship could be insured as it is now and have the restrictions of the insurance contract programmed into it (meaning that it may be less likely to violate the terms, so it would increase the odds of the insurer paying and preventing incidents from such violations).

5.3 (c) Insurance

Insurance is the means by which claims under maritime law against a shipowner tend to be met. By imposing direct liability on ships the burden of compulsory insurance would be on the ship and not the shipowner. As Vladeck notes, imposing insurance requirements on the ship instead of strict liability on the maker would be another way of spreading the financial burden [8]. Maritime law conventions often include provisions for compulsory insurance, so the financial burden is spread as it is, so strict liability may not be necessary. However, the error in Vladeck's statement is that implies that it is a choice between compulsory insurance and strict liability. Yet maritime law will often combine the two for better claimant protection.

5.3 (d) Wilful misconduct defence in insurance

In the provisions for compulsory insurance, the insurer is allowed to utilise any defences that the shipowner is entitled to, and additionally when the claimant takes direct action against the insurer they utilise the defence that it was the wilful misconduct of the shipowner. This means that the shipowner will be liable from their finances, and the insurer will not pay. Importantly, the claimant will still be entitled to damages, though if taking direct action against the insurer, it will require the claimant to take the shipowner themselves to court.

The same could apply to ships – if the ship autonomously misconducted itself wilfully the insurer could avoid liability. Such misconduct may even be easier to establish, as the system could be prevented from fraudulently hiding that misconduct and the data recordings would be analysed automatically in the case. Then the finances of the ship (like a corporation) would be used to pay damages to claimants.

However, this defence may be worrying for claimants when autonomous systems and machines represent an unknown risk. It could be a concern that wilful misconduct will be become more prevalent, and the security that comes through an insurer will not be as available – thus defeating the purpose of compulsory insurance provisions.

5.3 (e) Compensation from a central fund

Central funds are a common component of numerous maritime conventions (e.g. FUND) in addition to compensation from the shipowner. Central funds are used to complement compensation from the shipowner (or their insurer). It is made of contributions from various parties. For instance, for the FUND for damage from oil pollution there is a levy on receivers of oil in State Parties (above a set amount), the cost of which is then passed onto the consumer. It is considered to be a pillar of how the conventions operate in order to ensure effective compensation.

However, the question becomes whether central funds would still be able to operate effectively if ships are unmanned and operate solely through smart technology. This question is whether these contributions will still be made.

This writer concludes that these contributions will still be made, as they are not made by the shipowner. For instance, under the FUND the contributions are made by receivers of crude or heavy fuel oil through a levy. Therefore, differences in the nature of the ship will not affect their roles as cargo receivers. Therefore, compensation will still be available under central funds.

5.5 WHICH REMEDIAL MEASURES ARE PRACTICAL?

Although the physical attributes of the ship allow for the imposition of greater remedial measures, this writer concludes that this is not viable, as it would introduce too much inconsistency between ships. The imposition of legal personhood is based on system developments, and thus in other areas of the law not as many remedies would be available for systems with similar capabilities (e.g. *in rem* arrest could not apply for systems without a physical presence). Therefore, the remedies should be those available for corporations as legal persons: fines in criminal law, and damages in civil law. This prevents maritime law being more severe on smart technology

than other areas of the law, while also allowing for consistency between all ships and shipowners.

6. CONCLUSIONS

This paper assumed that the conventions and all other maritime law should still apply to a smart ship based on the purpose of the ship (e.g. dry-bulk cargo, oil tanker, passenger ship), and not involve a separate liability system for smart ships. This would represent to greater change in the law, and it is better to treat ships as equally as possible: fundamentally they are still ships, and ships before smart technology. The question considered in this paper, is whether they should mean the existing law is interpreted differently, so that liability is imposed on another party.

Although it is interesting to consider imposing liability on the manufacturer or the ship both are concluded to be unlikely. To encourage development and remain as similar as possible to current maritime law, liability should be channelled to the shipowner. Additionally, due to various types of smart ships (e.g. remote-controlled ships logically are the responsibility of the user, who is principally the shipowner) it is clearer to hold them all liable in the same way and the best way to do this is to hold the shipowner liable.

In relation to imposing liability on the ship, it is concluded that it is simply not practical. It raises a lot of confusion, despite the benefits that can it provide (e.g. justification for ship arrest, and providing more remedies than in relation to other forms of artificial intelligence). It would represent to greater change to the scope of liability for legal persons (in relation to autonomous smart ships). Therefore, liability should remain on the shipowner and not the smart ship.

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8. REFERENCES

1. MARITIME UNMANNED NAVIGATION THROUGH INTELLIGENCE IN NETWORKS, 'Impact on Short Sea Shipping', 2015. Available from: http://www.unmanned-ship.org/munin/wp-content/uploads/2015/10/MUNIN-D10-1-Impact-on-Short-Sea-Shipping-MRTK-final.pdf.

2. VAN HOOYDONK, E., 'The Law of Unmanned Merchant Shipping – an Exploration', *Journal of International Maritime Law*, 2014.

3. LANOUE, S., 'Computer Software and Strict Products Liability', *San Diego Law Review*, 1982-3.

4. LONGDIN, L., 'Liability for Defects in Bespoke Software: Are Lawyers and Information Scientists Speaking the same Language?', *International Journal of Law and Information Technology*, 2000.

5. HALLEVY, G., 'The Criminal Liability of Artificial Intelligence Entities – from Science Fiction to Legal Social Control', *Akron Intellectual Property Journal*, 2010.

6. HALLEVY, G., 'Unmanned Vehicles: Subordination to Criminal Law under the Modern Concept of Criminal Liability', *JLIS Special Edition: The Law of Unmanned Vehicles*, 2012.

7. NYCUM, S., 'Liability for Malfunction of a Computer Program', *Journal of Computers, Technology and Law*, 1979-80.

8. VLADECK, D. C., 'Machines Without Principals: Liability Rules and Artificial Intelligence', *Washington Law Review*, 2014.

9. DAHIYAT, E. A. R., 'Towards New Recognition of Liability in the Digital World: Should we be More Creative?', *International Journal of Law and Information Technology*, 2011.

10. UNION OF CONCERNED SCIENTISTS, 'Overwhelming Risk: Rethinking Flood Insurance in a World of Rising Seas' 2013. Available from: http://www.ucsusa.org/sites/default/files/legacy/assets/documents/global_warming/Overwhelming-Risk-Full-Report.pdf.

11. HALLEVY, G., 'The Criminal Liability of Artificial Intelligence Entities', *Social Science Research Network*, 2010.

12. CHWEDCZUK, M., 'Analysis of the Legal Status of Unmanned Commercial Vessel sin U.S. Admiralty and Maritime Law', *Journal of Maritime Law & Commerce*, 2016.

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