



Identifying factors affecting salvage rewards of crewless vessels — lessons from a case study

Mayank Suri^{1,2} · Krzysztof Wróbel³

Received: 22 September 2021 / Accepted: 30 April 2022 / Published online: 19 May 2022
© World Maritime University 2022

Abstract

The disruptive technology which is proposed to allow for unmanned or autonomous operations has garnered attention both on land and at sea. The lack of a crew on board poses interesting and complex challenges for the operations of sea-going vessels. Our study dwells into one such challenge, i.e. the issue of determining a salvage reward of a crewless vessel. This is a study cutting across operational and legal issues since the law of ships is closely connected to the practice of mariners. We look at a recent incident which can be used to make analogous comparisons with what could, one day be the salvage of a crewless vessel. We propose that immense thought should be given to the study of salvage as a legal subject for crewless vessels. Our study finds that most of the traditional elements of a salvage reward are highly dependent on human centric factors which will be affected by a lack of crew. We argue that a less discretionary and more standardised formula should be put in place to determine salvage reward for crewless vessels. We also propose that a changing shipping eco-system would require changes to the understanding of salvage as a professional service.

Keywords Maritime autonomous surface ships · MASS · Crewless vessels · Salvage · Salvage reward

1 Introduction

The fourth industrial revolution is affecting virtually all industries, and maritime trade is not immune to it. Technological progress has already led to increased automation and reduced manning (Bertram 2002). Nowadays, it is postulated that

✉ Krzysztof Wróbel
k.wrobel@wn.umg.edu.pl

¹ Jindal Global Law School, OP Jindal Global University, Sonipat, India

² Centre for Maritime Law, National University of Singapore, Singapore, Singapore

³ Research Group On Maritime Transportation Risk and Safety, Gdynia Maritime University, Gdynia, Poland

the number of seafarers operating a merchant vessel can be reduced to zero and several commercial projects are undertaking construction of such vessels (Porathe 2016). The rationale behind such a revolution is based on a promise that crewless (IMO MSC 2020) vessels would solve the problem of seafarer shortages (Kooij and Hekkenberg 2021), be cheaper to operate (Kretschmann et al. 2017; Ziājka-Poznańska and Montewka 2021; Bogusławski et al. 2022), safer than manned ones and more environmentally friendly (Goerlandt 2020). Although there is some scepticism to at least some of the above (Wróbel et al. 2017), it remains indisputable that the shipping industry seeks to gain technological advancements by increasing the level to which vessels are automated to the maximum (Suri 2020). It is expected that the industry will to some extent adopt crewless technologies within the next few decades (Maritime Safety Committee 2018).

Nevertheless, there are some problems that remain to be solved before the technology can become socially acceptable and commercially viable. Among these, there is a need for reliable and secure communication, accurate risk quantification or safety analysis and issues in respect of legal instruments (IMO Autonomous shipping n.d.). Within the latter, the very legal status of a crewless vessel as a ship is discussed (Allen 2012; Hasan 2022) along with more detailed aspects of the vessel's operations, including potential malfunction of algorithm or machine learning issues generalised as product liability issues (Ferreira 2018), insurance coverage and survival of traditional maritime practices such as salvage (Pietrzykowski and Hajduk 2019). At the same time, courts of law are unwilling to absolve liability from humans just because they rely on a computer system to navigate correctly (Appeal 1989). However, a vessel which suffers an engine breakdown, seemingly unrepairable at sea, in other words, unable to manoeuvre, will most certainly be considered in danger, requiring salvage to extricate it out of the situation (Admiralty Court 2008). Similar situations of danger can be expected for crewless vessels, regardless of cause.

To this end, salvage remains under-investigated despite its paramount importance to both protection of economic benefit to shipping operations and protection of environment (ISU (2021)). Despite the fact that salvage costs are of an extraordinary nature which are not required to be accounted for during usual operations, they can create a deep hole in a shipowner's pocket when they are incurred (ISU 2019). This is because the underlying principle of salvage is that a generous reward is owed to those who retrieve property from danger (Rose 2021).

The legal enquiry into salvage is often complicated and marked by an astute sense over intertwining principles (for example, the moral duty to rescue a ship in imminent danger, as compared to, salvage as a commercial service). This overarching sense that salvage law can be interpreted and applied as a standard makes references to abstract values such as promptness, success and professionalism that are ascribed to relative standards of time, effort and skill, giving it a strong discretionary nature which has found functional acceptance in courts of law. As Charles Sutton pointed out in the discussion to his paper titled 'An Enquiry into the Assessing of Salvage Awards' presented to the Royal Statistical Society in the year 1944, 'I approached it from the position that, despite many years' practical experience of salvage awards, I was quite unable to give myself any rational

explanation for any figures I was called upon to give or consider. Nor could I gather any explanation by discussion or reading. No two combinations of circumstances were ever recognisably similar enough to use for comparison of one figure of award with another and even when they were reasonably similar it was still impossible to say whether any particular figure of award was a regular or irregular one' (Sutton 1945).

We discuss ahead in our case study, how the task of valuing a specific vessel has remained discretionary and abstract, not being comparable to even vessels of the same type, age and size. With few prototypes in operation as of April 2022, the technology of crewless maritime transportation is a big unknown in terms of their design, operational features, economics and legal issues. Being a disruptive technology, crewless shipping is only going to amplify the divergences in the shape, structure and features of ships, thereby creating new possibilities of their salvage, the topic of evaluating the salvage reward appears to be important and valid. The crew of the salvaged vessel and the salvors are the primary humans present in a salvage operation and they are important witnesses (and assets) to the operation, their testimonies being material for establishing facts about the operation. The removal of the crew from the salvaged vessel will result in the salvor undertaking operations 'unassisted' or 'independent'. We analyse this situation and thus, we make no difference between remotely controlled and autonomous ships by focusing on the fact that they are crewless, meaning that there is no crew on board.

In the present analysis, we are going to analyse an English judgment which applies the current internationally accepted law for salvage, codified as, *The Convention for the Unification of Certain Rules of Law relating to Assistance and Salvage at Sea, 1989* ('the International Convention on Salvage, 1989'). This convention was not a subject of IMO's regulatory scoping exercise in substantive terms, objective of which was to evaluate whether autonomous ships (all four degrees of autonomy) would fit in the current legal framework. The objective of the exercise explains why the conclusion reached was that MASS can be incorporated by 'developing interpretations'. However, it is of little dispute that the traditional risks associated with salvage operations will transform owing to unmanned operations (Veal 2021). For instance, the lack of a crew on board the casualty will reduce a traditional risk, i.e. risk to life of the crew. At the same time, this would perhaps result in unassisted salvage, increasing the effort and skill required by the salvors, akin to salvage of abandoned vessels. It is also foreseeable that issues with respect to the command and control of the crewless vessel itself would hamper salvage operations. To put this in context, would there always be a possibility to restart the engines or ballast system from a Remote Control Centre ('RCC') or would a physical intervention for external reset be required. Given the variance in climatic conditions and the inherent danger element prompting salvage, the latter proposition seems to increase the reasonable efforts and costs akin to operations where salvors are dropped on board by a helicopter.

Whereas the historic rule underlying a salvage reward is 'no cure, no pay', i.e. where the salvaged property is not taken out of the degree of risk it was at, prior to salvage taking place, no award will accrue in favour of the salvors (PD 1883).

To this extent, some preliminary questions arise, would crewless vessels be easily salvable? Given that crewless ships would be unconventional to the current shipping landscape, difficulties in their interactions with other ships, and therefore, salvors, are rather reasonable to imagine. If the degree of risk as well as reciprocal skill and effort of the salvors is increased, would it result in a higher reward?

1.1 Criteria for fixing the salvage reward

In this study, we are particularly concerned with the ‘criteria for fixing the reward’ which is mentioned in article 13 of the convention. The opening lines of the article state that ‘The reward shall be fixed with a view to encouraging salvage operations...’. By mentioning, in the main text of the article, the policy of ‘encouraging’ salvage operations, the convention sets the ball rolling in favour of the salvors when a court is applying the criteria (Reports 1948). In other words, a court of law, adjudicating an award of salvage under the convention, must allocate a portion of its award to an intangible or unaccountable head, the sole purpose of which is to encourage salvage operations (Swan 2009). Swan highlights that in awarding salvage, a court seeks to balance the policy of encouragement enshrined in the convention versus the risk of an unfair contract being signed by the salvee.

Article 1 (e) on *Definitions* states that ‘(e) Payment means any reward, remuneration or compensation due under this Convention’. Article 12 (1) mentions the word ‘reward’ where it is stipulated as a ‘right’ accruing to the salvor in consequence of a ‘useful result’ of salvage operations. Regard should be paid to the general rule of ‘no cure, no pay’ which existed as an ancestor to the convention (AC 1925), to recognise that salvage has historically been an extraordinary service, the failure of which would lead to no reward (Rose 2002). Baughen states that in case of no ‘useful result’, a court would award a ‘quantum meruit payment under an implied contract’ (Baughen 2015, 292). This in fact has been observed by Admiralty Registrar Master Jervis Kay QC,¹ in the case we study ahead, noting that salvage is a special kind of gratuitous service recognised in English law as giving rise to a right to an award, whereas all other services need to be based in an express or implied contract for services to be adjudged *quantum meruit* (Reports 2020a). These observations support that a salvage ‘reward’ is a payment judged on higher notions, unlike payment for services that are more in the nature of remuneration or payment for losses that are more in the nature of compensation.

Crewless shipping promises to reduce risk to human lives by removing the crew and reduce risk of pollution by discarding conventional fuels. In this sense, crewless ships remove several factors that underline the policy to ‘encourage’ salvors. In this backdrop, our case study analyses these and other elements of crewless ships to note their effect on various heads of criteria for calculating salvage rewards. To this end, the objective of the present study is to investigate factors having an impact on the calculation of salvage reward for crewless vessels. This is achieved through a case study.

¹ Hereinafter referred to as ‘the judge’.



Fig. 1 Grounded Kuzma Minin aerial footage (BBC 2019)

1.2 Case study — Kuzma Minin

In order to realise results which are practical and useful, we investigated a recent case where the Admiralty High Court of England and London had to decide a salvage reward under article 13 of the convention as incorporated in the English Merchant Shipping Act 1995. This case is well suited for such an enquiry for various reasons including the following:

- The fact that claimants herein took an alternative plea of *quantum meruit* which the court declined in favour of a salvage reward;
- The case comes from UK an active and informed maritime jurisdiction;
- The judgment applies the criteria mentioned under article 13 to the facts of the salvage operation;
- There was legal representation by experts in commercial and maritime matters;
- The size of the ship and other circumstances of the case provide a useful specimen for reaching analogous observations for crewless vessels;
- The case was well documented by government agencies and media outlets thereby providing a graphic picture of the events, see Fig. 1 (BBC 2019).

Therefore, presented below are some analogous observations for crewless shipping:

1. The vessel was a bulk carrier, and these are among the ships that are expected to be one of the first to become crewless due to their relative technical simplicity (Rødseth and Burmeister 2012; Burmeister et al. 2014);

2. Having anchored after a realisation that it will not be possible to reach the port of destination (Ceuta), the vessel effectively executed the ‘minimum risk condition’ as a safety measure introduced in (DNV-GL 2018), in anticipation of unfavourable weather conditions — yet, this did not save the vessel from grounding;
3. The vessel was facing conditions in which some of the vessel’s stores were depleted (no matter the reason for so) and could not be easily obtained by her crew;
4. The vessel encountered an unexpected yet not unlikely complication of anchor entangled in a chain — a situation difficult to handle even by crewed vessels, let alone crewless ones where there is no device proposed to handle such abnormal situations;
5. The accident occurred near shore where communication channels were available just as is prescribed for prospective crewless ships — yet, there was a major problem in communicating with a ship manager and thus the vessel was salvaged without any shore-based institution acting on the vessel’s behalf (both operationally and legally);
6. The nature of salvage operation required that lines are secured on board, this act involves the crew directly — a feature unlikely to be achieved by a crewless vessel.

Due to the above, it can be anticipated that similar cases will become part of the crewless shipping business. Not on a daily basis, hopefully, but seemingly also would not be a legal peculiarity or a purely academic problem.

2 Synopsis

2.1 Factual information

A summary of the facts leading up to the salvage operation is as follows:

Kuzma Minin grounded after dragging its anchor in Falmouth Bay, England and was successfully refloated on the next high water. Damage included shell plate deformation and breached tanks. The vessel dragged its anchor in strong winds. Although the movement towards the shore was quickly detected by the bridge watchkeeper, the actions taken to proceed to sea were interrupted by the anchor becoming fouled by a discarded length of anchor chain. As focus was turned to clearing the anchor, Kuzma Minin was blown towards the shore at a speed of over 2 knots. (GOV.UK 2019).

While it is the current law in England to not admit MAIB reports in judicial proceedings for allocating liability (Reports 2020b), we are using the factual information and the citation in order to present a clear picture of the incident from a technical perspective.

We now analyse the judgment as per the heads (a–j) provided under article 13 of the convention.

2.2 Analysis

(a) *The salved value of the vessel and other property*

Legal analysis The first determining factor of the salvage rewards is the salved value of the vessel and the property. Given that this element represents something tangible, i.e. physical property, it would seem that it would be easier to determine its value. *Sutton* has referred to this ability to mentally translate a set of physical circumstances in terms of money as the ‘central feature of making of salvage awards’. The judge refers to a plethora of authorities to establish that salved values are to be assessed at the place and time when the salvage operation is terminated such as *The George Dean* (1875) Swab 290, *The Gaupen* (1925) 22 Ll.L.Rep 271, *The Yolaine* [1995] 2 Lloyd’s Rep 7, *The Ocean Crown* [2010] 1 Lloyd’s Rep 468; and, Kennedy & Rose: *Law of Salvage* [9th Ed] 569.

The method is to appoint experienced valuers who provide certificates of valuation as per *The Kia Ora* (1918) 252 Fed Rep 507. Notably, the judge observes that this role cannot be transferred to a computer algorithm since it relies on data provided to it (in the case, the claimant’s lawyers relied on a software called *Vessels Value*). The judge states that ‘The valuation of a vessel is a matter of expert evidence where a qualified witness expresses an opinion based upon the information available to him’. It would seem that the judge here has, though ignorantly, made reference to *Sutton*’s ‘central feature’ argument and has observed that the algorithm is incapable of translating the money value of every physical circumstance and certainly not as reliably as a human valuer. A valuation is scrutinised on grounds of reasonability by employing objective factors such as age of vessel, size of vessel, cargo capacity and freight earnings, and, subjective and often abstract factors, such as nature and extent of damage, wear and tear. The objective factors can be calculated easily by an algorithm but the situation is murkier in respect of subjective factors. As *Sutton* points out, determining the salved value is of ‘overriding importance, since for precisely similar degrees of peril, difficulty and expense, entirely different awards will be made’. The judge rejected the comparable values of 10 other vessels proposed by the claimants. The general rule that *Sutton* presents (of salved value being of overriding importance) applies even today given its place in article 13 and the primacy of salved value in creation of the salved fund. Additionally, the objective and subjective factors are presented to an admiralty judge by the valuer, who then determines the fair salved value (*Sutton* 1945; Teitelbaum 2012).

The judge takes into account the sale value from a court sale of the vessel which took place 3 months after the termination of the salvage operation, value of the bunkers on board at the time of salvage and deducts from these, the estimated repair costs. The repair costs are estimated because there is no actual information provided to the judge because the vessel is sent for scrapping instead.

Importance for crewless shipping The valuation for Kuzma Minin was performed on a ‘similar vessel’ basis where purchase price of vessels of a similar type, age and condition were used as benchmark. This may be a correct course of action and a well-established custom for those vessels that are not significantly different from one another. With crewless vessels in question, there may be additional issues to be taken into consideration. These may include the degree to which the vessel is automated (i.e. number, age and quality of electronic devices installed), rate at which the hardware depreciates (in light of absent regular maintenance at sea) and compatibility of the vessel’s electronic systems with those of potential buyers. Wherever control systems constitute a significant portion of initial investment and their value depreciates over time, the price of the vessel can no longer be calculated based on the benchmark of scrap metal value and weight. In respect of crewless vessels, the installation of advanced hardware and software systems on board would naturally inflate the total value of the vessel because of the high value systems on-board that become a part of the ships equipment and ordinary fittings.

Moreover, at least initially, the ‘similar vessel’ basis would not be feasible for determining the value of the salvaged ship, precisely due to the difference in initial investments between traditional and crewless ships. The difference is conservatively estimated to be as much as 10% (Kretschmann et al. 2017). Such calculations would need to be carried out more carefully.

(b) *The skill and efforts of the salvors in preventing or minimising damage to the environment*

Legal analysis The facts of the case point out that there was 129.6 tonnes of Heavy Fuel Oil (‘HFO’) and 29.5 tonnes of Marine Diesel Oil (‘MDO’) on board the vessel. The judge observed that it was ‘sufficient to cause a significant amount of pollution’ agreeing with the claimant that there was a real risk of leakage (paragraph 62²). However, the cost of oil on board represents only an addition to the salvaged value. The spirit of this element is the protection of marine environment. Thus, the balance that needs to be struck is between an estimated liability if the oil had leaked and cost of the oil. Also, there is seemingly an abstract value attributable to ‘skill’ and ‘effort’ since it is not based on a quantifiable factor, for example, expenses of the salvors. However, it has been said that the skill and efforts of salvors are the primary drivers of an encouraging reward (Teitelbaum 2012). The payment of expenses covered in situations where there is a threat to environment represents a compensatory attribute that has been discussed widely and a resultant industry reaction of which is the SCOPIC clause (Chiu et al. 2017).

² Hereinafter, *paragraph number* refers to respective paragraphs within (Reports 2020a).

Importance for crewless shipping The circumstances of preventing or minimising the damage to the environment may turn out to be of lesser importance for crewless vessels. It is already widely acknowledged that fossil fuels are no longer a sustainable way of providing ships with energy, and alternatives are being sought.

It is unclear whether crewless ships would be allowed to transport dangerous goods or other noxious substances. Even if they are not, such substances could be transported either for technical reasons (lubricating oils, ammonia fuels) or as misdeclared cargo (Wróbel et al. 2017). Therefore, the risk will remain valid and its minimization shall be promoted especially given the fact that the crewless ship's control system would only have limited capabilities of handling a situation.

This portion of the salvage reward may therefore be higher for crewless ships, particularly if they run on fuel oils. Once the ship's ability to contain noxious substances is compromised, it will only be up to salvors how much of it makes it to the environment. Any effort in limiting it shall be properly rewarded, but the calculation of such reward would still need to be performed based on actual information pertaining to the type of noxious substance, its quantity on board and quantification of an averted risk of spill.

This was also the case for Kuzma Minin as she carried large quantities of fuel oils which are widely considered to be the most relevant maritime pollutant (Chen et al. 2019). Other potentially noxious substances carried in small quantities were not subject of consideration. Nevertheless, it has been argued that crewless vessels will likely have limited capabilities of handling the pollution emergency on their own, thus depending on external assistance in this respect (Wróbel et al. 2017).

(c) *The measure of success obtained by the salvor*

Legal analysis Although the judge does not treat this head as a separately defined one while quantifying the salvage reward, it is evident from the references that the weightage bestowed upon the success of the salvage plays a part in the general quantification of the award. Success is understood as the shifting of the salvaged property from a position of danger. A salvage operation is said to be at end when the salvaged property is made safe again (AC 1925). However, issues arise when one tries to denote a degree to the successful operation. The measure of success seems bound to the timely response of the salvors and the prevention of further damage. In so, measuring the success of the salvors, the prescriptive qualities in the words of the judge are these 'services performed were of the highest order, promptly rendered and at considerable risk to personnel and equipment' (paragraph 74). It can be said that while it is easy to identify a successful salvage from an unsuccessful one, the measure of success and damage remains largely an exercise of judicial discretion as is evident from the use of adjectives instead of values in the judgment.

Importance for crewless shipping The measure of success obtained by the salvor appears to be one of the most difficult to calculate. In general, it can be assumed that as the damage (of whatever nature) increases, the success rate decreases. With

entropy increasing in time, the damage always increases unless it is prevented, for instance by professional salvors. The very fact that salvaging exists as a service indicates that crews' abilities to handle accidents are limited, let alone those of control systems and mechanisms of crewless vessels. The latter would have their risk mitigation capabilities limited, by design. Meanwhile, the accident itself is by definition of an unexpected and unpredictable nature. If it were not, it would easily be avoided.

To this end, it can be inferred that time plays a crucial role in obtaining the success in salvage operations, and thus — measuring it. In the case of Kuzma Minin, 'time' was of importance due to the action of the tides leading to fear that if the vessel is not refloated promptly, then some serious structural damage may occur. The crew had no way of acting effectively in such a situation and relied completely on external help, which arrived timely, although with some delay related to mobilisation of assets.

Given that prospective crewless vessels are expected to have extremely limited capabilities of responding to hazards, only a timely reaction of salvors would help restrict the extent of damage. This underlines the requirement for ensuring that no delays appear due to formal reasons, i.e. lack of agent representation acting on behalf of the ship operator (owner), Lloyd Open Form (LOF) negotiations or lack of insurance certificate. Instead of wasting time on the above, salvors shall be dispatched to the site immediately. Bellying a u-turn from contractual salvage which has become the norm in recent times (Chiu et al. 2017).

It shall also be kept in mind that Kuzma Minin accident occurred near-shore, in a densely populated and industrial area. The issue of ensuring the salvage being successful through reducing the response time gets another dimension when considering acting in the middle of the ocean, in pirate-infested waters or remote locations like the Arctic. It has also been pointed out that the usual salvage reward is on the rise given the society's expectations about protection of environment (Chiu et al. 2017).

Regardless of the above, it can be expected that the remuneration for salvage, in its part related to the measure of success, would be greater for crewless vessels than it used to be for manned ones. The utmost reason for this would be that the success would come from a sole action of salvors, which would act without any assistance from the crew at all. The considerations in this discussion point to an overburdened shipowner through a future contract of salvage. Possible balance can be struck between the competing interests of the salvors and the shipowners by calculating rewards based on costs to salvors instead of the total salvaged value like in the JSE 91 form (Chiu et al. 2017).

(d) *The nature and degree of the danger*

Legal analysis It would be reasonable to assert that the degree of danger to which a salvaged vessel is exposed considerably affects the urgency for salvage. As *Baughen* points out, the underlying reason for salvage reward is the preservation of property from danger (Baughen 2015, 286). *Swan* reflects on this particular aspect from an angle of transaction costs stating that lack of immediate danger lowers transaction

costs and the inverse increases it (Swan 2009). Therefore, a reasonable conclusion seems to be ‘more the danger, higher the reward’. However, once the salvage operation has been conducted and successfully so, on what basis is the degree of danger determined? This was the issue faced by the judge in the *Kuzma Minin*. Under the head ‘the dangers facing the vessel’, the judge goes into an investigation of facts as he is meant to, since every situation will be a question of fact. It is interesting to note the prescriptive qualities the judge assigns here to the facts exhibiting the element of danger. He considers the vessel to be in ‘considerable danger’ given the fact that the vessel has grounded and lost the capability to extricate herself from this position. The fact that the vessel itself could not do anything to reduce the danger it was in seems to have been a material factor in the assessment of a heightened degree of danger, whereas there seems to be these contributing factors: age of vessel, tidal range, condition of vessel, rocky shoreline, heavy pounding, expectation of bad weather and actual damage in relation to grounding duration.

Importance for crewless shipping The degree of danger is to a great extent evaluated subjectively based on the factual information but also on statements of witnesses. The basis for the analysis is to determine what could go wrong if the salvage were unsuccessful and how bad the damage could be. This is unlikely to change for crewless vessels. However, given that they would operate based on the analysis of quantitative data from various sensors, there might be the case that such data would be stored and made available for determining the actual conditions of both environment and the vessel. The datasets would be more extensive than those available from Voyage Data Recorders. Given that more information might be available, some subjective statements as to the expected dangers could be verified, but their interpretation would still be up to humans with their experience, as well as biases. We have already made reference to the debate in *Kuzma Minin* where the judge was disinclined to follow a purely computerised valuation. It would remain to be seen whether courts would allow records of datasets from sensors to speak for themselves or would opinion by experts outweigh such records.

(e) *The skill and efforts of the salvors in salving the vessel, other property and life*

Legal analysis For this criterion to be varied among different incidents, there needs to be a material difference in the nature of the salvage operations such as one brought on because of the type of vessel involved or an extraordinary situation with the waves and winds or an extraordinary situation such as fire. As skill and effort represent personal abstract concepts, it seems that success or failure would be the qualifying factors. Within success or failure, the degree of difficulty will be a measure of skill and effort. It can be gauged that an accidental rescuer may face more difficulty than a professional salvor. Although, since the advent of professional salvage services, courts have been more willing to equate professionalism with higher awards (Lords 1997). *Swan* argues, much in accordance with the speech of Lord Mustill in the *Nagasaki*

Spirit case, that the reason for this, is the policy of encouraging the salvage industry. One can see this in the analysis of the judge in *Kuzma Minin* where he studies the competing witness accounts and makes a finding that ‘However the fact that they were prepared to co-operate with each other, is, in my view, highly meritorious and deserves encouragement’ (paragraph 75). However, who is a professional salvor is a question of fact. As it turns out, the judge comes to a finding that the entities involved in the *Kuzma Minin* operation are not professional salvors (paragraph 75). Critically, the judge makes a separate head called ‘the status of the claimants’ and under this head, he comes to the conclusion that ‘It is not simply a matter of being dubbed a ‘professional salvor’ or not and the status of each claimant needs to be regarded on its own merits in order to assess the level of encouragement for that organisation’. This seems to be a pragmatic approach since the international salvage industry is quite heterogeneous in its structure and organisation (ISU 2018). This intra-industry variance is going to be further amplified with the use of crewless salvage vessels since then the applicable ‘skill and effort’ will by implication include a RCC operator or a machine learning device (Kongsberg Maritime 2021).

Importance for crewless shipping Given the lack of crew, salvors of crewless vessels would likely need to perform the entirety of the operation. This might require an ability to not only attach towing lines to ship’s bollards while operating from tugs but perhaps also board the vessel (perhaps from a helicopter, if at high seas), repair the vessel’s hardware and software systems, etc. Not every company would be able to meet such requirements, so such services might be extremely costly in both reduced market competition but also due to higher operational costs and risks involved in the operation. This leaves only for professional salvors to handle the most complex, dangerous and rewarding accidents, perhaps with the assistance of local sub-contractors: tug operators, divers, etc. As was the case in *Kuzma Minin*, professional salvors would be paid higher than non-professional ones.

Nevertheless, the issue can be raised whether such salvors of a crewless ship can be rewarded for saving *lives*. Since there is normally no living person on board such ship, the default answer would be negative. Moreover, the salvage operation *traditionally* is not about saving life, but property. Perhaps, the question of whether meaning of ‘life’ should extend to cover marine and aquatic life would become rather important in the future. The reward might therefore be somewhat reduced as salvors would not need to take into account the matters of crew well-being during the operation and might focus purely on salvaging the property. In other words, one may reflect on the ‘effort’ of a salvor reducing in order to not make provision for saving lives. The same reasoning may percolate to a discussion on ‘skill’.

(f) *The time used and expenses and losses incurred by the salvors*

Legal analysis This head of the reward is far easily ascertained than abstract values represented by ‘skill’ and ‘effort’. That is so since expenses can be easily quantified

although the value of time may be not. The judge has therefore relied on vouchers and invoices where available to settle an amount for expenses. However, even where these are not available, the judge's discretion in respect of a particular item of expense will matter. For example, for a rigid inflatable boat used by the salvors, contentions are made by the parties and there is no conclusive evidence of its hire amount. The judge considers it 'a matter to be taken into account in assessing the award rather than as a specific expense of the services' (paragraph 68a). However, the judge does not exercise such discretion for consumables replaced after use in the operation, because the invoices for these could be easily procured and their absence point towards some exaggeration on part of the claimants. In other words, the burden to prove expenses falls on the claimants and must be discharged. Losses incurred by the salvors may not be capable of being invoiced or vouched; however, they hold a recognised place in the convention. In *Kuzma Minin*, it is easily argued that payment towards losses may be called 'overcompensation'. It seems to stem from the argument that salvage reward is a remedy in restitution. However, as *Swan* argues, a modern salvage reward 'does more than merely reverse an unjust enrichment' and therefore an economic analysis (over the theory of restitution) is better suited to modern operations. Of this, it must be said that an economic analysis sits well in the scheme of things when one recognises that salvage rewards are now characterised by their inclusion of several very specific factors that are seemingly more quantifiable now than they were in the past. For example, the cost of a salvage vessel's winch may be easily ascertainable now as a separate independent part owing to decentralised manufacturing in the shipbuilding/spare parts industry.

Importance for crewless shipping It is foreseeable that a crewless ship owner may wish to enter in contracts of contingency for future salvage operations. Given that a more professional approach would be needed for salvaging crewless vessels, the rates for such services would be higher. Any dispute in this matter aiming to reduce (for ship owner benefit) or increase (for salvor benefit) the rate would result in potentially big changes of the reward, given that the starting point is higher than it is today.

The same applies to expenses and losses. Given that more sophisticated equipment would need to be used and put to risk, its usage would be more costly. Such costs would need to be included in the amount awarded to the salvor.

(g) *The risk of liability and other risks run by the salvors or their equipment*

Legal analysis The *Kuzma Minin* incident took place in shallow waters at the heels of the UK coast. Other than the ship in danger and the salvors, there were no other vessels close by. Therefore, third-party liability aspect was only relegated to environmental concerns. However, the risks run by the salvors were debated, especially in respect of their view of the weather conditions. However, within the judgment, there are references, in a piecemeal fashion, to general factors to be taken into account

while calculating the award. The judge is disinclined to make a separate head to adjudicate aspects which would fall under this discussion. *Sutton* had pleaded that awards should be assessed while following ‘consistent broad lines’. It is pertinent to acknowledge that with higher adoption of information technology, generalisation of this sort will make for uneasy acceptance. Replacement of human functions with technology has been pursued to remove/reduce the chances of error; and, general factors do not sit well in this, precision setting.

Importance for crewless shipping The aspect of reward calculation for risk of liability or other risks is greatly related to actual conditions in which the salvage operation is performed. The efforts undertaken by salvors may or may not affect other assets in vicinity.

On the part of risk to salvors themselves, it may be easily raised that this can in some cases be greater. This is in part due to the fact that, even though quantitative data on vessel and environment condition might be available, these may not give the full picture. In normal circumstances, salvors would consult the crew to gain additional information pertaining to risks they may encounter. The crew would then seek the answers beyond technical capabilities of sensors and control systems so that all involved in the operation gain an as-full-as-possible picture of the situation. If that is missing, the uncertainties increase and so does the risk. However, as *Kuzma Minin* case shows, cooperating with the crew, although crucial, can be difficult. In this particular case, this might be due to the fact that the crew was demoralised by long detention of the ship in a previous port and perhaps, the feeling of abandonment by the ship owner. As for the latter, there was no cooperation from its side whatsoever. Performing a salvage operation without direct link between the salvors and the ship owner might prove extremely difficult. The UK Maritime Autonomous Systems Regulatory Working Group in its latest industry guidelines mentions that ‘MASS owners should co-operate as fully with salvors’ as an obvious acknowledgment of the uphill task that a salvage of crewless ships represents (MASRWG 2020).

(h) *The promptness of the services rendered*

Legal analysis As already pointed out, the judge concludes that the services rendered were prompt. This head of claim can only exist as an abstract factor for general consideration of the salvage reward. Although, there may exist some general rules which rule out promptness, such as failure of salvage, unreasonable delay in deployment and negligent delay in deployment. If one looks at the intervenor’s arguments on this point, it would seem that their argument of lack of ‘swiftness’ is made to imply delay on the part of the salvors (paragraph 23 h). In fact, there are multiple references to the time taken by the salvors to mobilise various vessels without any supporting legal argument. One can only speculate that the intervenors were trying to appeal to this abstract factor, as if expecting the judge to state that the time taken was unreasonable by construing some extrinsic facts. However, it does seem that

promptness is linked to the element of danger, since any increase in degree of danger once the salvage operation has started will call into question the response time of the salvors.

Importance for crewless shipping With regard to assigning crisp numerical values on a salvage reward or its part, in circumstances of somewhat hasty response to the real danger, it is understandable that legal representatives may try to use any advantage. In this paragraph, an opportunity is offered by a somewhat fuzzy notion of *promptness*. It can only be judged in hindsight whether a service was rendered *promptly* unless a specific timeframe was established at some point.

(i) ***The availability and use of vessels or other equipment intended for salvage operations***

This criterion is analysed along with (j) for the reasons presented therein.

(j) ***The state of readiness and efficiency of the salvor's equipment and the value thereof***

Legal analysis We are taking these two criteria together since in the judgment they have been clubbed together under one head, i.e. the status of the claimants. There are references to the vessels and equipment in other places within the judgment which seem to have contributed more generally to the judge's opinion of the award. It has been said that the status of the salvors is of consequence only when it is intended towards a purposeful result. Therefore, categorising a salvor as 'professional' should only matter when objective tests of 'availability, use, readiness and efficiency' are employed. The rationale is that a salvor maintaining salvage equipment and vessels would expect a higher reward in comparison to a salvor who uses his general commercial use equipment and vessels for salvage when the need arises (paragraph 63). Similarly, this salvor may expect a higher reward than a smaller player which is not a salvor in any sense. Interestingly, this discussion lends weight to the policy of encouragement of salvors and even emboldens a stance under restitution, since a professional salvor's work would be deemed to be causing unjust enrichment of a different kind to the salvaged ship. This approach also aligns with the theory that skill and effort of the salvors can be adjudged in light of degrees of difficulty in a way to counteract the effects of one another. It is almost certain that a difficult salvage would require higher skill and effort but it is also true that a novice/under-skilled/unprofessional salvor will face more difficulty. In holding that the claimants are not professional salvors, the judge nevertheless acknowledges their willingness to perform salvage services as deserving of an encouraging reward. It seems that through piecemeal but direct references to special measures taken by the salvors, such as having a provision of an oil boom on standby, the judge is at least in an abstract fashion increasing the quantum of the reward to satisfy the policy of encouragement.

Importance for crewless shipping It shall be again underlined that salvaging a crewless vessel might require a higher level of expertise and equipment sophistication.

Maintaining the readiness of respective assets would be costly and so professional salvors might expect that related expenses would be covered by remuneration from salvee.

3 Discussion and policy impact

With crewless ships yet to achieve full-scale implementation, no hard data pertaining to their operational and safety record is available. It can nevertheless be expected that eventually some of them may require salvage. The latter is a service, and as such is subject to a financial coverage. The amount is ascertained in courts of law on a regular basis, with certain factors traditionally taken into consideration. These in turn are based on a long experience in evaluating the success and effort undertaken in salvaging ships in cooperation with their crews. This tradition may prove unsuccessful in estimating the reward for salvaging of crewless vessels as these are likely to have a completely different design, operational aspects, technical complexity and financial value (Wróbel et al. 2018). Therefore, at least initially, there would hardly be any basis on which salvage reward could be calculated, due to the lack of precedent cases. This issue is amplified because several disputes, which may hold helpful clues, in respect of salvage rewards, remain silent within the ever-quiet walls of arbitration chambers.

It can be raised that operations in which derelict (literally, *crewless*) vessels were salvaged could be used as a starting point, but these are extremely rare and complex cases. They are, by definition, no crew onboard to aid in the operation and so the salvors must handle the situation on their own. On the other hand, such cases may not be fully applicable as there might be some degree of control over the crewless vessel performed remotely from a RCC or by the vessel's own control system.

Nevertheless, our analysis suggests that the reward for salvage of crewless vessels will probably be larger than for manned ones due to the greater complexity of the former, lack of experience in salvaging these and greater skill required. However, the very fact that these cases are resolved in courts indicates that a case-by-case approach is both needed and applied. It can also be affected by potential new legal instruments introduced by the IMO to embrace autonomous shipping. It is suggested that a brand-new MASS Code might be a proper way of handling this issue holistically (IMO 2021). Regardless the way new ships are handled legally, it is a practice of courts that is likely to plot the course for future detailed calculations of the salvage rewards of crewless vessels.

The performed analysis also revealed that practical aspects of salvage operations are quite different from their legal setup. As in the case study, salvage operation complicates when no support from ship's owner is available — an issue that is likely to be amplified in the case of crewless vessels. In order to avoid such complications, a possibility of establishing a 'global salvage agreement' to secure salvaging the crewless vessel is suggested as a main policy recommendation of this study. Such global salvage agreement would aim in assuring that the crewless vessel does not leave the port without a warranty that the vessel will be salvaged anywhere in the world (or in a limited geographical area, to which operations of such vessel would

be restricted) directly or indirectly by a company with sufficient operational capabilities. This would mean employing relevant staff, hardware and sub-contractors, sufficient for any kind of salvage operation. Moreover, ensuring compatibility of the global salvors' software and hardware with ship's and owner's systems might prove necessary. In order to ensure the availability and cyber-security of such form, it could be stored in an electronic or even decentralised form, perhaps using blockchain technology. The contract would then be activated once the vessel operator identifies a condition directly endangering the vessel's safety. Among these can be loss of power or failure of communication link that appears to be non-resolvable by either the vessel herself or the RCC. Termination of such a contract, regardless the reason, would inevitably need to render the vessel unseaworthy with no regard for keeping the hard copy on board. Moreover, such 'global salvor' would need to be constantly informed of a vessel's operational status. Finally, given the time constraints and an effective lack of the owner's representative (Master) on site, local salvors undersigned by a 'global salvor' must be authorised to access the vessel and perform any action on the vessel. If that were the case, measures must be taken to ensure that security of vessel and its cargo is not jeopardised in the process.

There are also some additional questions that arise from the case study. For instance, whether the loss of communication link between the RCC and the crewless vessel could give rise to a salvage event by itself. There is some judicial precedent that indicates if a salvor rescues a ship from incurring third party liability, a salvage reward is made out (Reports 1934). *The Whippingham* provides a purposeful basis of believing that salvage for crewless vessels will be rewarded. If it is apprehensible that a crewless vessel may malfunction, then its ability to cause harm should not be discounted. If in a kill switch situation, the crewless vessel finds herself abandoned or adrift without power, the reason for immediate salvage may be to prevent it from causing loss to third-party assets.

The analysis herein was burdened with uncertainties normally encountered in analysing a case study. It was based on analysing court and other documents and can therefore only address information contained therein. Moreover, conclusions based on a case study not necessarily need to reflect the general overview of the phenomena in question. The scope of crewless shipping, being a highly innovative, disruptive and un-verified technology, these uncertainties are further magnified by the unclear shape of the future of the industry, along with its legal setup.

4 Conclusions

The Kuzma Minin case becomes a reasonable example, by no means exhaustive, of what one may expect when a crewless ship grounds. There is an obvious increase on the efforts, skills and equipment of the salvors in rescuing such a ship because the lack of a crew. However, as several factors are abstract in nature, the discretion used in reaching an award is high. An agreement cannot be reached under such circumstances, if the parties involved do not so wish. For a global salvage agreement to be in place, the conflicting interests of the salvors, the shipowners and the environment agencies would have to be taken into consideration. The friction that is inevitable in

negotiating such a contract may be wriggled out of by adverting to a formula for calculating salvage rewards. This may be more favourable for shipowners where they would not have the advantage of an eye-witness account. The formula should be merged with a system that standardises salvage practices. Indeed, with the increase in global conglomerates that absorb various sectors, industries and functions, a standardisation in practices could be achieved. The lack of crew also reduces the weight of the element of danger; however, it may be said that this can be counteracted by the danger to environment. The age-old principle of encouraging salvors to rescue property at sea would still apply to crewless ships, albeit with the motive to protect the environment and commercial interests of the shipowner. Also, the lack of crew would confuse, possibly, the understanding of what is an ‘imminent’ danger but at the same time an abstraction of what is the value of the crew’s lives would also be reduced. Therefore, the right to demand salvage, traditionally vested in the Master, would also become a commercial call than a nautical one. It may thus be said that where a purely crewless salvage takes place, i.e. a crewless ship being rescued by one or more crewless salvage ship(s), the need for a formula will increase since all the human actors would be based on land undermining the urgency that is usually related to safety of life at sea. However, as brought out above, given the history of exercising discretion, codification of only some elements of salvage award and no clear standards of practice; it will be a tricky road for inventing and agreeing to a formula for calculation of salvage reward for crewless shipping. Although, it will be more welcome in the fourth industrial revolution.

Acknowledgements The authors are grateful to two anonymous reviewers for their comments which helped us improve the initial version of the manuscript.

Author contribution MS: conceptualization, methodology, investigation, resources, writing — original draft and supervision. KW: methodology, investigation and writing — review and editing.

Funding The second author was supported by Gdynia Maritime University internal grant WN/2022/PZ/12.

Data availability Not applicable.

Declarations

Conflict of interest The authors declare no competing interests.

References

- AC (1925) *San Onofre v Melanie*, (1924) 20 Lloyd’s Law Reports 89 (House of Lords)
- Admiralty Court (2008) *The Voutakos*, (2008) 2 Lloyd’s Law Reports 516 (England & Wales High Court)
- Allen CH (2012) The seabots are coming here: should they be treated as vessels? *J Navig* 65:749–752. <https://doi.org/10.1017/S0373463312000197>
- Appeal C of (1989) *R v Donald Niven McNair and Peter Garratt Masters*, (1989) 11 Criminal Appeal Reports Sentencing 465 (Court of Appeal)
- Baughen S (2015) *Shipping Law*, 6th edn, Routledge

- BBC (2019) Russian cargo ship grounded off Falmouth still detained in UK. <https://www.bbc.com/news/uk-england-cornwall-50812186>. Accessed Jun 2021
- Bertram V (2002) Technologies for low-crew/no-crew ships. In: proceedings of forum captain computer, Brest. <http://utopia.duth.gr/~agaster/papers/cite/Ships.pdf>. Retrieved 9 Jun 2021
- Bogustawski K, Gil M, Nasur J, Wróbel K (2022) Implications of autonomous shipping for maritime education and training: the cadet's perspective. *Marit Econ Logist*. <https://doi.org/10.1057/s41278-022-00217-x>
- Burmeister H-C, Bruhn W, Rødseth ØJ, Porathe T (2014) Autonomous unmanned merchant vessel and its contribution towards the e-navigation implementation: the MUNIN perspective. *Int J e-Navigation Marit Econ* 1:1–13. <https://doi.org/10.1016/j.enavi.2014.12.002>
- Chen J, Zhang W, Wan Z et al (2019) Oil spills from global tankers: status review and future governance. *J Clean Prod* 227:20–32. <https://doi.org/10.1016/j.jclepro.2019.04.020>
- Chiu CS, Liu CP, Chang KY et al (2017) Cost of salvage—a comparative form approach. *J Mar Sci Technol* 25:742–751. <https://doi.org/10.6119/JMST-017-1226-15>
- DNV-GL (2018) Class Guideline: Autonomous and remotely operated ships. <https://rules.dnv.com/docs/pdf/DNV/cg/2018-09/dnvgl-cg-0264.pdf>. Accessed 9 Jun 2021
- Ferreira F (2018) Regulatory and liability issues of autonomous surface vehicles. University of Pisa
- Goerlandt F (2020) Maritime autonomous surface ships from a risk governance perspective: interpretation and implications. *Saf Sci* 128:104758. <https://doi.org/10.1016/j.ssci.2020.104758>
- GOV.UK (2019) Grounding of bulk carrier Kuzma Minin, Accident Investigation Report 11/2019, 1 August 2019
- Hasan S (2022) Analysing the definition of “ship” to facilitate marine autonomous surface ships as ship under the law of the sea. *Aust J Marit Ocean Aff* 0:1–16. <https://doi.org/10.1080/18366503.2022.2065115>
- IMO Autonomous Shipping (n.d.) https://www.imo.org/en/MediaCentre/HotTopics/Pages/Autonomous_shipping.aspx. Accessed 9 Jun 2021
- IMO (2021) IMO's Maritime Safety Committee finalizes its analysis of ship safety treaties, to assess next steps for regulating maritime autonomous surface ships (MASS). <https://www.imo.org/en/MediaCentre/PressBriefings/Pages/MASSRSE2021.aspx>. Accessed 9 Jun 2021
- IMO MSC (2020) Proposed terminology for MASS. London
- ISU (2021) ISU statement regarding Ever Given refloating, Suez Canal, 29 March 2021, <https://www.marine-salvage.com/isu-statementregarding-ever-given-refloating-suez-canal/>. Accessed 9 Jun 2021
- ISU (2019) Annual Review. https://www.marinesalvage.com/wp-content/uploads/2020/07/ISU_Annual_Review_2019.pdf. Accessed 9 Jun 2021
- ISU CC (2018) Charo Coll, ISU, An assessment of the current state of the marine salvage industry. <https://www.marinesalvage.com/media-information/conference-papers/an-assessment-of-the-current-state-of-the-marine-salvage-industry/>. Accessed 9 Jun 2021
- Kongsberg Maritime GHM (2021) GH Midtbo, Kongsberg, Recotug Pushes Towage Operations Into The Future. <https://www.kongsberg.com/maritime/the-full-picturemagazine/2021/5/recotug/>. Accessed 9 Jun 2021
- Kooij C, Hekkenberg R (2021) Identification of a task-based implementation path for unmanned autonomous ships. *Marit Policy Manag* 00:1–17. <https://doi.org/10.1080/03088839.2021.1914878>
- Kretschmann L, Burmeister H, Jahn C (2017) Analyzing the economic benefit of unmanned autonomous ships: an exploratory cost-comparison between an autonomous and a conventional bulk carrier. *Res Transp Bus Manag* 25:76–86. <https://doi.org/10.1016/j.rtbm.2017.06.002>
- Lords H (1997) *Semco Salvage & Marine Pte Ltd v Lancer Navigation Co. Ltd*, (1997) 1 Lloyd's Law Reports 323 (House of Lords)
- Maritime Safety Committee IMO (2018) Maritime Safety Committee (MSC), 100th session, 3–7 December 2018. <https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MSC-100th-session.aspx>. Accessed 9 Jun 2021
- MASRWG (2020) UK Maritime autonomous systems regulatory working group, maritime autonomous surface ships industry conduct principles & code of practice version 4. <https://www.maritimeuk.org/media-centre/publications/maritime-autonomous-surface-ships-industry-conduct-principles-code-practice-v4/>. Accessed 9 Jun 2021
- PD (1883) *The Camelia*, 9 PD 27
- Pietrzykowski Z, Hajduk J (2019) Operations of maritime autonomous surface ships. *TransNav Int J Mar Navig Saf Sea Transp* 13:725–733. <https://doi.org/10.12716/1001.13.04.04>

- Porathe T (2016) A navigating navigator onboard or a monitoring operator ashore? Towards safe, effective, and sustainable maritime transportation: findings from five recent EU projects. *Transp Res Procedia* 14:233–242. <https://doi.org/10.1016/j.trpro.2016.05.060>
- Reports L law (1948) *The Queen Elizabeth*. 82 Lloyd's Law Reports 803 (England & Wales High Court)
- Reports L law (2020a) *Keynvor Morlift Ltd v the vessel "Kuzma Minin"*, 2 Lloyd's Law Reports 617 (England & Wales High Court)
- Reports L law (2020b) *The Ocean Prefect*. 2 Lloyd's Law Reports 654 (England & Wales High Court)
- Reports L law (1934) *The Whippingham*. 48 Lloyd's Law Reports 49 (England & Wales High Court)
- Rødseth ØJ, Burmeister H-C (2012) Developments toward the unmanned ship. In: *Proceedings of International Symposium Information on Ships-ISIS, Hamburg*. <http://www.unmanned-ship.org/munin/wp-content/uploads/2012/08/R%25C3%25B8dseth-Burmeister-2012-Developments-toward-the-unmanned-ship.pdf>. Retrieved 9 Jun 2021
- Rose FD (2021) Silver salvage services, 2 Lloyd's Maritime and Commercial Law Quarterly 227. <https://www.i-law.com/ilaw/doc/view.htm?id=418788>. Accessed 9 Jun 2021
- Rose FD (2002) *Kennedy & Rose: The law of salvage*, 6th edn, Sweet & Maxwell
- Suri M (2020) Autonomous ships and the proximate cause conundrum - a maritime and insurance law Tango. *J Marit Law Commer* 51:163–185
- Sutton C (1945) *An Enquiry into the Assessing of Salvage Awards* 108:41–92
- Swan C (2009) The restitutionary and economic Analyses of salvage law, (2009) 23 (1) *Australian and New Zealand Maritime Law Journal* 99. <https://classic.austlii.edu.au/au/journals/ANZMarLawJl/2009/10.html>. Accessed 9 Jun 2021
- Teitelbaum JC (2012) Inside the blackwall box: explaining U.S. marine salvage awards. *SSRN Electron J* 22:55–121. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2060973. Accessed 9 Jun 2021
- Veal R (2021) Autonomous technology in shipping; an increased role for negligence product liability? In: *Autonomous Ships and the Law (IMLI Studies in International Maritime Law)*. Taylor and Francis, 278
- Wróbel K, Montewka J, Kujala P (2017) Towards the assessment of potential impact of unmanned vessels on maritime transportation safety. *Reliab Eng Syst Saf* 165:155–169. <https://doi.org/10.1016/j.ress.2017.03.029>
- Wróbel K, Montewka J, Kujala P (2018) Towards the development of a system-theoretic model for safety assessment of autonomous merchant vessels. *Reliab Eng Syst Saf* 178:209–224. <https://doi.org/10.1016/j.ress.2018.05.019>
- Ziajka-Poznańska E, Montewka J (2021) Costs and benefits of autonomous shipping—a literature review. *Appl Sci* 11:4553. <https://doi.org/10.3390/app11104553>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Correction to: Identifying factors affecting salvage rewards of crewless vessels—lessons from a case study

Mayank Suri^{1,2} · Krzysztof Wróbel³

© World Maritime University 2023

Correction to: WMU Journal of Maritime Affairs (2022) 21:213–232
<https://doi.org/10.1007/s13437-022-00276-0>

The authors would like to correct the following passages:

1) Under section 1, on page 3: instead of

“In the present analysis, we are going to analyse an English judgment which applies the current internationally accepted law for salvage, codified as, The Convention for the Unification of Certain Rules of Law relating to Assistance and Salvage at Sea, 1989 (‘the International Convention on Salvage, 1989’). This convention was not a subject of IMO’s regulatory scoping exercise in substantive terms, objective of which was to evaluate whether autonomous ships (all four degrees of autonomy) would fit in the current legal framework. The objective of the exercise explains why the conclusion reached was that MASS can be incorporated by ‘developing interpretations’. However, it is of little dispute that the traditional risks associated with salvage operations will transform owing to unmanned operations (Veal 2021).”

should read

“In the present analysis, we are going to analyse an English judgment which applies the current internationally accepted law for salvage, codified as, the International Convention on Salvage, 1989. It is of little dispute that the

The original article can be found online at <https://doi.org/10.1007/s13437-022-00276-0>

✉ Krzysztof Wróbel
k.wrobel@wn.umg.edu.pl

¹ Jindal Global Law School, OP Jindal Global University, Sonapat, India

² Centre for Maritime Law, National University of Singapore, Singapore, Singapore

³ Research Group On Maritime Transportation Risk and Safety, Gdynia Maritime University, Gdynia, Poland

traditional risks associated with salvage operations will transform owing to unmanned operations (Veal 2021)."

2) Under section 1.2, on page 5

"In order to realise results which are practical and useful, we investigated a recent case where the Admiralty High Court of England and London had to decide a salvage reward under article 13 of the convention as incorporated in the English Merchant Shipping Act, 1995."

should read

"In order to realise results which are practical and useful, we investigated a recent case where the Admiralty Court of the High Court of Justice, England and Wales, in London, had to decide a salvage reward under article 13 of the convention as incorporated in the English Merchant Shipping Act, 1995."

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.