Regulatory SAR issues related to maritime autonomous surface ships (MASS)

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EXECUTIVE SUMMARY

The following bachelor thesis addresses the potential judicial and ethical SAR challenges that could occur with the introduction of autonomous ships. The principle of having seafarers onboard has been central in the creation of the legal framework. The maritime conventions of SOLAS and UNCLOS have precise SAR phrasings in which autonomous ships needs to be accounted for. Interpretations, definitions and exemptions that could potentially create challenges will be analysed and discussed.

The research question "What could be considered the major SAR challenges regarding MASS operations?" will be explored through a qualitative study based on interviews with an expert panel of prominent figures in the maritime industry. The relevant theory will be collected through a literature review of judicial publications on MASS which helped to limit the scope of the thesis by establishing relevant topics for an interview guide.

By comparing the answers obtained through the interviews, there were both unanimous agreement and deeply imbedded moral discrepancies. The main findings included challenges of both legal and ethical concerns. It quickly became evident that the SAR regulations of today will have to be reworked from its core in order to serve its purpose. However, the main challenge uncovered was the apparent gap in moral expectations of assisting in SAR between a master mariner and the shore-based interviewees.

PREFACE

The bachelor thesis "Regulatory SAR issues related to maritime autonomous surface ships" is the result of an explorative study on a topic that evokes discussions across multiple professions. The collection of data was comprehensive and sometimes challenging in relation to the explorative design.

It has been written as part of the graduation requirements of the Shipping Management Program at the Norwegian School of Science and Technology (NTNU). The project was undertaken as part of an internship at DNV GL.

We would like to thank our supervisor, Marte Fanneløb Giskeødegård, for valuable guidance and input throughout the project period. We would also like to thank all our interviewees for their beneficial and indispensable contribution and insight to autonomy. Furthermore, a big thank you to DNV GL, who has contributed with great advisors, guidance and a network to relevant people in the maritime industry.

Finally, we would like to thank *H. Westfal-Larsen og Hustru Anna Westfal-Larsens Fond til unge Personers Utdannelse for Rederinæringen* for funding of the internship which made it possible for us to focus our time on working on this bachelor thesis during the project period.

ACRONYMS

HMI	Human Machine Interface
ICT	Information and Communications Technology
IMO	International Maritime Organization
LoA	Length Overall
LOA	Level Of Autonomy
MASS	Maritime Autonomous Surface Ships
MSC	Maritime Safety Committee
NMA	The Norwegian Maritime Authority
PR	Public Relations
RCC	Remote Control Centre
SAR	Search and Rescue
SBO	Shore Based Operator
SOLAS	Convention of Safety of Life at Sea
SOLAS V/33	Convention of Safety of Life at Sea Chapter V Regulation 33
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
UNCLOS	United Nations Convention on Law of the Sea
UNCLOS 98	United Nations Convention on Law of the Sea Regulation 98

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1 INTRODUCTION

When Yara announced their order for a fully autonomous container vessel in 2017, the idea of an unmanned commercial ship took a massive leap towards reality. However, the assumed oncoming wave of autonomy in the maritime industry is a complex subject. Auto pilotage and automation on the bridge itself have seen constant development and the number of people onboard commercial trade ships have steadily decreased. Some will claim that the shipping industry has had a rule of thumb; the crew onboard commercial ships have a "half-life" of approximately 50 years. Arguments can, therefore, be made that unmanned ships are not an entirely unexpected "game-changing" event.

The current focus on maritime autonomous surface ships (MASS) is mostly surrounding technology. What requirements that need to be set in order to facilitate operation, increased efficiency and fulfil technical class requirements have been extensively covered. As the principle of having seafarers onboard has been central in the creation of the legal framework, removing the human aspect will pose not only technical challenges but also significant judicial and ethical challenges. Identifying and addressing these challenges is therefore considered essential in order to facilitate for MASS operation.

The topic of the bachelor thesis has been defined as "Regulatory SAR issues related to MASS". The duty to render assistance to people in distress at sea applies to all ships regardless of ship types by being incorporated in both SOLAS, most national laws, and UNCLOS. We found identifying these SAR challenges interesting as none of the current commercial autonomous projects had addressed the issue of sufficient SAR abilities or how to handle this obligation. The importance of complying to these regulations, both legally and ethically, will be displayed by examples in the following background chapter.

The issue will be explored through a qualitative study based on interviews with an expert panel of prominent figures in the maritime industry. The relevant theory will be collected through a literature review of judicial publications on MASS which helps to limit the scope of the thesis by establishing relevant topics for the interview guide. Of the scope defined, we have formulated the following research question:

“What could be considered the major SAR challenges regarding MASS operations?”

Within this question lies identifying challenges within the judicial and ethical dimensions of search and rescue at sea. The bachelor thesis will mainly focus on regulatory issues. That being said, many of the judicial challenges also raised several ethical questions which also needs to be considered.

The purpose of the thesis, as described by our research question, is to identify regulatory issues within the legal and ethical dimensions of search and rescue at sea. We want to highlight consensus, controversy and ambiguities surrounding the oncoming wave of autonomy and aim to identify where the problems lie.

Many publications and online articles address that there are legislative dilemmas and point to the ethical challenges without further elaborating on the underlying causes. In the ethical context, we wish to address these underlying causes by not only pointing to where they exist but also investigating why. To answer the research question, a width in the participants' experience and background has been evident in order to portray a nuanced picture of the different viewpoints in the industry. What do the participants predict and think within the specified dimensions of SAR?

1.1 Assumptions and limitations

A balance between feasibility and future opportunities has been strived when developing the study basis. However, certain assumptions must be made in order to identify emerging risks and challenges following the research question. Of which, the assumption that autonomous ships will have a prominent role in the future of shipping is fundamental when justifying the chosen scope and relevance of this thesis. There are currently several ongoing IMO activities with the aim to identify the need for amending IMO provisions, which will allow for the operation of ships with a higher degree of automation. When studying MASS at a conceptual stage, it is essential not to limit the capability to what is seen feasible today, but at the same time not be too futuristic. Being too futuristic can invalidate the results and create a sense of unrealism.

This topic attracts excellent discussions and even more significant disagreements. To address the issue, we have chosen to limit the thesis by defining a set of parameters. The following limitations apply for this study:

Level of autonomy

The study scenarios are limited to an A2-B0 ship level of autonomy as defined by the IMO.[1] This is a remote-controlled ship with no seafarers on board, but with qualified seafarers available at a remote location. The ship is controlled and operated from a remote control centre (RCC). These definitions of autonomy levels were submitted to IMO's Maritime Safety Committee (MSC) 100/5/6 by Australia, Denmark, Finland, France and Turkey.

Table 1 - MSC 100/5/6 proposal for the level of autonomy and control

			No qualified operators on board but qualified operators available at a remote location	Qualified operators on board
Levels of autonomy	A2	**Supervised** The qualified operator is always informed of all decisions taken by the system. Permission of the qualified operator is not required for the ship system to execute functions, decisions and actions; the qualified operator can override the system at any stage.	A2-B0	A2-B1
	A3	**Autonomous** The qualified operator is informed by the system in case of emergency or when ship systems are outside of defined parameters. Permission of the qualified operator is not required for the ship system to execute functions, decisions and actions; the qualified operator can override the ship system when outside of defined parameters. Provided the boundaries of the ship system are not exceeded, "human control" becomes "human supervision".	A3-B0	A3-B1

Legal framework and technical aspects

The bachelor thesis bases the discussion on SAR on the interpretation of SOLAS Chapter V, Regulation 33, and UNCLOS Article 98. In terms of interpreting the laws, these regulations are assumed most relevant as they are the most universally implemented legislations regarding SAR.

Furthermore, the thesis wishes to shed light on different dimensions of MASS but aims to exclude the technical aspect of this issue. The MUNIN project has received much

[1] Imo.org. (2019)

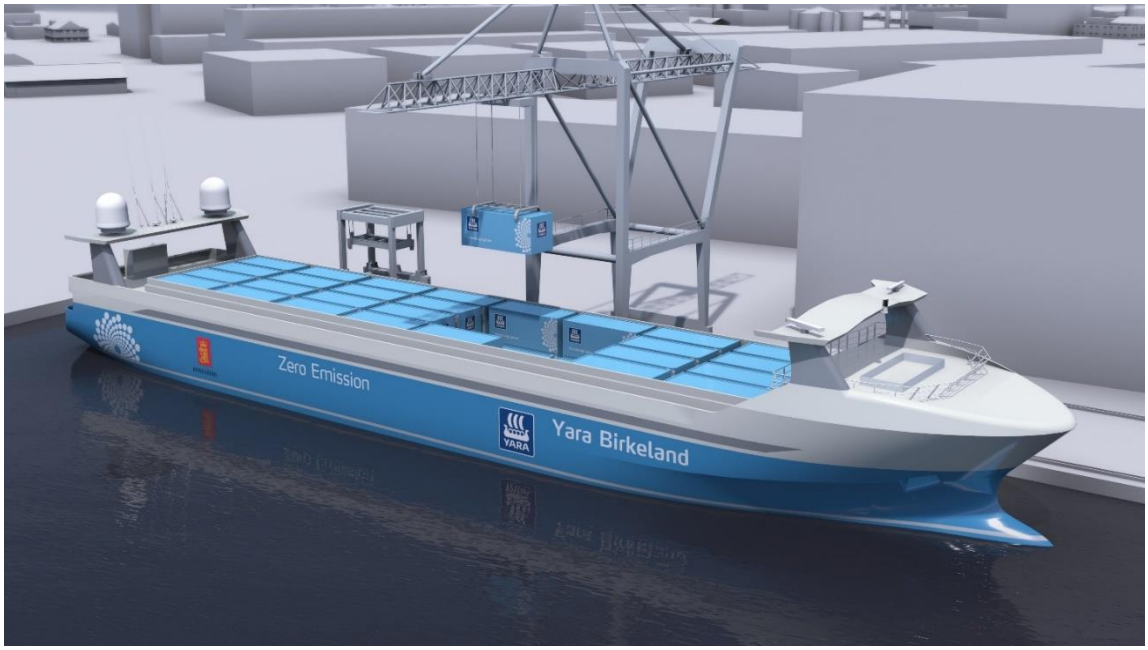
attention and has had a significant role as a pioneer, in the debate on autonomous shipping. We have chosen not to elaborate further on this project as it involves too many technical aspects.

It is also worth mentioning that MASS will likely open for countless new opportunities concerning SAR. This is briefly touched upon, but as the thesis is focusing on identifying the challenges, this aspect is neither elaborated.

1.2 Background

In order to establish a more thorough background for this bachelor thesis, the Yara Birkeland project will be showcased in an attempt to illustrate how far autonomous ships has come as of today. There will also be a presentation of SOLAS V/33 and the UNCLOS 98 conventions as they will be the legislative regulations in focus. To illustrate the importance of complying with these regulations, two very different reactions to SAR obligations will be explored.

Autonomy in the maritime industry



Yara Birkeland, by Kongsberggruppen, Innovasjon Norge, Public Domain.

Yara Birkeland is by many viewed as the spearhead of MASS. The ship will initially be humanly crewed to start with, but the plan is to make it entirely unmanned and controlled by an onshore control station within the first two years of service. This will

define it as an autonomy degree A2-B0 vessel.[23] The president and CEO of Yara Svein Tore Holsether have stated the following regarding the project; "As a leading global fertilizer company with a mission to feed the world and protect the planet, investing in this zero emission vessel to transport our crop nutrition solutions fits our strategy well. We are proud to work with Kongsberg to realise the world's first autonomous, all-electric vessel to enter commercial operation"[4] For all that; it is essential to note that Yara is not a traditional shipping company. Yara is mainly a producer of fertilizer, and although Yara will indeed operate the ship, the company behind the technology itself is Kongsberg. The company states the following regarding themselves "Always at the forefront of marine technology, KONGSBERG is a key player in the digital transformation of operations at sea, with a leading position in the development of autonomous vessels. With data key to efficiency, KONGSBERG is as committed to information management as to developing sophisticated automation and control technology for ships."[5]

Nonetheless, there is one important note to make: as of today (2019), Yara Birkeland is far behind schedule and has yet to see any time at sea. One of the main reasons for this is by many claimed to be both technical and regulatory issues.[6]

As of today, the formal application of establishing a test area with legislative exemptions for Yara Birkeland has been signed and approved by the Norwegian Maritime Authority.[7] IMO has also launched a scoping exercise in order to comply with their "strategic direction" of "Integrating new and advancing technologies into the regulatory framework".[8]

[2] Jiang, J. (2017)

[3] Imo.org. (2019)

[4] Jiang, J. (2017)

[5] Kongsberg.com. (2019)

[6] Svw.no (2019)

[7] Ship Technology. (2017)

[8] Imo.org. (2019)

SOLAS chapter 5 regulation 33

SOLAS

The word SOLAS is an abbreviation, and SOLAS full form is “Safety Of Life At Sea", an international maritime treaty, also known as the SOLAS Convention or International Convention for the Safety of Life at Sea (SOLAS), which establishes the least safety measures in the construction, equipment and operation of merchant ships. In simple terms, The International Maritime Organization was later established to regulate and develop the framework for international maritime law, including the SOLAS convention. The current version is known as "SOLAS 1974" and came into force on the 25th of May 1980. As of today (2019), the convention has 164 contracting states and flags about 99% of merchant ships around the world in terms of gross tonnage. SOLAS, in its consecutive form, is regarded as the most important treaty of all international treaties regarding merchant ships.[9]

Chapter 5

SOLAS 1974 includes Articles setting out general obligations on followed by an annexe of twelve chapters (as of 2019). In 2016 and 2017, two new chapters were added. Of the twelve chapters, chapter 5 is the only one that applies to all vessels on the sea. This chapter incorporates everything from small crafts, private yachts and Suezmax commercial tankers. Most countries have constituted SOLAS chapter 5 into their national laws which makes anybody in breach with the requirements and obligations subjects to legal proceedings.[10]

Regulation 33

SOLAS chapter 5 contains 35 regulations and 25 annexes. The main focus in this thesis will be on how autonomous ships will comply with regulation 33 “Distress situations; obligations and procedures”. SOLAS was produced at a point in time where autonomous ships was not yet a concept. As will be presented under the literature analysis, discussions regarding the legislations appliance to autonomous ships have

[9] Marine Insight. (2019)

[10] Marine Insight. (2019)

evoked. This section, however, will display the regulation itself and phrase some of the sections.

Section number 1 of regulation 33 states as follows: "The master of a ship at sea which is in a position to be able to provide assistance on receiving information from any source that persons are in distress at sea, is bound to proceed with all speed to their assistance if possible informing them or the search and rescue service that the ship is doing so. This obligation to provide assistance applies regardless of the nationality or status of such persons or the circumstances in which they are found. If the ship receiving the distress alert is unable or, in the special circumstances of the case, considers it unreasonable or unnecessary to proceed to their assistance, the master must enter in the log-book the reason for failing to proceed to the assistance of the persons in distress, taking into account the recommendation of the Organization, to inform the appropriate search and rescue service accordingly."[11]

Questions raised by section number 1 is how to define how "...in a position to be able to provide assistance…." can apply to an autonomous ship with no capability to either rescue or search for persons in distress due to not having a crew.

UNCLOS Article 98

The UNCLOS convention is probably mostly known for the controversies regarding territorial claims at sea. However, UNCLOS is also the primary United Nations agreement on maritime SAR. SOLAS is solely subject to IMO, which has 174 members while UNCLOS is subject to the United Nations with its 193 member states (UNCLOS: 168 parties). This bachelor thesis will make SOLAS the regulation of reference in SAR situations by cause of it being the earliest and therefore laying the groundwork for the majority of SAR regulations. Due to the latter SOLAS has also had a more significant role in the subjects of the Shipping Management degree. However, UNCLOS Article 98 will be referred to both in the interviews and the literature review. As previously mentioned, UNCLOS being a much more recent convention, has established the

[11] Marine Insight. (2019)

majority of its SAR regulations directly from SOLAS. Underneath is UNCLOS article 98 (1) which is the "judicial twin" of SOLAS V/33:[12]

"1. Every State shall require the master of a ship flying its flag, in so far as he can do so without serious danger to the ship, the crew or the passengers:

(a) to render assistance to any person found at sea in danger of being lost;

(b) to proceed with all possible speed to the rescue of persons in distress, if informed of their need of assistance, in so far as such action may reasonably be expected of him;

(c) after a collision, to render assistance to the other ship, its crew and its passengers and, where possible, to inform the other ship of the name of his own ship, its port of registry and the nearest port at which it will call.

Furthermore, section 6 states that "Masters of ships who have embarked persons in distress at sea shall treat them with humanity, within the capabilities and limitations of the ship.".[13]

Questions raised by section 6 is how embarked persons in distress will be treated with humanity when the legislation only states that it has to be done "within the capabilities of the ship" when the ship itself has no crew.

In order to display the importance of SOLAS chapter 5 regulation 33 this thesis will present two cases and the legal ramifications of said cases were the seafarers were acting within the requirements of SOLAS chapter 5 regulation 33 and where the seafarers did not comply with SOLAS chapter 5 regulation 33.

Choosing to act

"The Tampa Affair"

On the 26th of August, 2001, the Norwegian ship Tampa, under Captain Arne Rinnan, was sailing from Perth WA when it received a call for assistance. As mentioned in the previous section SOLAS is codified in international maritime law, and it obligates seafarers to render assistance to vessels in distress. SOLAS applies without regard to nationality, status and circumstances, and this is one of the many reasons as to why

[12] Imo.org. (2019)

[13] Imo.org. (2019)

"The Tampa Affair" evolved into international news. The distress call turned out to be a sinking Indonesian fishing boat containing 430 people, mainly Afghan refugees. The fishing vessel was breaking up in the heavy seas, and The Tampa arrived just in time to transfer those on board to its own decks. The vessel found it itself in international waters, and the closest port of safety was Christmas Island which is Australian territory. Although Australia was the first country to pick up the distress call and organize a search and rescue mission, the Australian Immigration Department forbade The Tampa to enter Australian territorial waters. The Australian Prime Minister himself threatened to prosecute Captain Rinnan as a people smuggler. Undeterred by this Captain Rinnan continued sailing towards Christmas Island, and as soon as The Tampa crossed the border, the ship was immediately detained by Australian Commandos. The refugees were forcibly transferred to a navy vessel and moved to detention camps on the Pacific island of Nauru. Norway later reported Australia to the United Nations for failure to comply with international law. However, the story of Tampa is not presented in this thesis with intentions to criticize a countries immigration policy. It is presented to show just how important it is for a seafarer to honour tradition, legislation and ethics at sea even in the face of severe personal risk.[14][15]

Choosing not to act

The Bow Eagle Incident

On the 26th of August 2002, the French registered fishing vessel “Cistude” collided with the Norwegian registered chemical tanker Bow Eagle. The collision resulted in the loss of 4 lives from Cistude and spilling of 200 tonnes of ethyl acetate from Bow Eagle. After the collision, Bow Eagle failed to stop to render assistance even though the original report clearly states that the crew on watch was aware of the collision;[16]

“After the PAN PAN PAN message (from the badly damaged Cistude) at about 03:45, the lookout (of the Bow Eagle) asked the officer to inform the master. The officer did

[14] Nma.gov.au. (2019).

[15] Kaldorcentre.unsw.edu.au. (2019).

[16] M. E. Manuel (2019).

not follow this suggestion. Instead, he demanded that the lookout keep the incident a secret -not to speak about it- which the lookout obeyed."[17]

The Bow Eagle kept going until retained by French naval authorities on direct demand from the Prime Minister of France Jean-Pierre Raffarin. The crew members thought to be responsible were immediately apprehended and faced with charges of manslaughter.[18]

One of the essential things to extract from this tragic incident is the fact that the collision itself is not the reason behind the manslaughter accusations. After all the fishing vessel was believed to be liable for the crash, however, it was the failure of Bow Eagles crew to render assistance that escalated the legal repercussions.

[17] M. E. Manuel (2019).

[18] M. E. Manuel (2019).

2 LITERATURE REVIEW

The literature review of this bachelor thesis will extract relevant material having been made on MASS and SAR legislation. There will be a brief introduction to the relevancy and applicable matters of the articles. Afterwards, all the SAR related discussions of each article will be presented.

An important note to make is that most of the literature surrounding autonomous vessels is based on technical aspects. When it comes to technological advancements, the legislation has a tendency of being post active, or rather, legislation is seldom discussed until there is an actual practical example of it being applied to a certain scenario. However, with regards to MASS, there have already been made judicial discussions and opinions have surfaced on how to apply the maritime law of today. As previously mentioned in the introduction, there is a, perhaps worryingly, lack of SAR related issues addressed from the perspective of the MASS-owners and engineers. All the literature presented in this bachelor thesis comes from authors with judicial backgrounds. However, the articles displayed were also the only ones addressing SAR related issues from an exclusively or mostly judicial and ethical approach. From all the literature read and reviewed the articles presented in this chapter distinguished the purpose of this bachelor thesis the most. Therefore they will be individually explored, and the relevant matters will be extracted and displayed.

All Hands Off Deck? The Legal Barriers to Autonomous Ships, By: Luci Carey (2017)

All Hands Off Deck is a Maritime Law Working paper that considers the legal position for an unmanned ship. Further, the article explains what autonomous ships need in order to comply with existing international and domestic maritime laws.

The introduction of the article emphasises on the same topics as displayed in the background chapter: “Disruptive technology is affecting all industries, and shipping is no exception. Commercial autonomous ships are soon to be realised, but before they can

operate internationally, there are significant legal hurdles to overcome".[19] The first legal hurdle to overcome is how the traditional role of the shipmaster will disappear. There must be a redistribution of the associated legal duties and liabilities among several actors. In many ways, the role of the master is usually seen from a navigational and hierarchical perspective. However, the master has a number of roles that extends beyond the latter. Both in International Conventions and through the domestic law of the flagged ship, the master has several legal duties and responsibilities. One of those international conventions is SOLAS which places a personal obligation on the master of a ship to render assistance to people or vessels in distress. The article states that "This is a major issue for an autonomous ship."[20]

The phrasing of SOLAS "which is in a position to be able to provide assistance" is discussed as a legislative challenge if the role of the master no longer exists: "As there is no master on board perhaps the autonomous ship will be relieved of this obligation completely while additionally, the fact that she cannot carry people creates a 'special circumstance' that makes it unreasonable to comply." Even if a person is appointed as a master, that individual could claim that he/she "will not be in a position to render assistance beyond alerting other ships or coastal authorities."[21] Even if the role of the master is transferred adequately to a person in control of an unmanned ship and the responsibilities of SOLAS accounted for there is still the bigger issue of the obligations of SOLAS V/33 being traditionally very difficult to enforce. "In order for a person who is not rendered assistance to successfully sue a master, they would first have to survive, identify the ship that failed to render assistance, and finally establish the correct jurisdiction over the master or the ship."[22] In the previously mentioned case of "Bow Eagle," there are arguments to be made that if this was to happen outside of European waters, there is a chance that the crew at fault could have been left unprosecuted. The article also mentions that these legal hurdles are even more difficult for the descendants of deceased victims. As it is very relevant today, the jurisdictional issues of criminally prosecuting a master in the circumstance of refugees and asylum seekers are signified.

[19] Carey, L.

[20] Carey, L.

[21] Carey, L

[22] Carey, L

The reason for this being that there are three jurisdictions that can prosecute the master; "the flag state of the vessel; or if the master does not share the nationality of the flag state, the country of which the master is a citizen; and the country of which the victim is a citizen."[23] To add to the latter a case where "the country of which the victim is a citizen" prosecutes a master is highly unlikely. "As of today, there have been (unsuccessful prosecutions) of masters and seafarers related to the Mediterranean migrant crisis for assisting irregular entry under aggravated circumstances. It appears there have been no prosecutions for failing to render assistance despite commercial vessels failing to assist drifting boatloads of migrants and refugees in the Mediterranean. How a prosecution would work against an autonomous ship is even more difficult to imagine, particularly if there is no one person that is the master."

When it comes to the moral code at sea, the article brings up the following points: "The duty to render assistance to persons in distress is a moral obligation as well as a legal duty."[24] And further substantiates the latter with "It is difficult to argue that those who profit financially from the operation of an autonomous ship can be immune from such (SAR) obligations."[25] To the sceptics of MASS and how it will comply with judicial and moral obligations to SAR, it will be very important that rescuing equipment and clear judicial expectations for contributing to SAR is made.

The Autonomous Shipping Era. Operational, Regulatory, and Quality Challenges By: A. Komianos (2018)

The article "The Autonomous Shipping Era. Operational, Regulatory, and Quality Challenges" further substantiates many of the points made in "All Hands Off Deck? The Legal Barriers to Autonomous Ships". However, the article contains some different perspectives regarding the conventions addressed in this bachelor thesis. First of all, the article states that both SOLAS and UNCLOS does not include autonomous ships as a concept or as a "modus operandi".[26] It is deemed inexpedient to apply or interpret the phrasing as "the existing regulations and the traditionally used phrasing challenge rather

[23] Carey, L

[24] Carey, L

[25] Carey, L

[26] A. Komianos

than facilitate the operational deployment of such vessels in the future."[27] Additionally, the role of master is discussed signifying the fact that the distancing from the ship and the sea itself might make cause barriers for an onshore master to intervene in SAR. Those barriers being not just the physical distancing, but also the fact that the master might be psychologically far apart from the situation.

As mentioned in the background chapter, there has already been established a testing area where MASS can be trailed with exemptions from the legislation. With this in mind, the article states that "The responsibilities of Contracting Governments and Masters include the assistance and embarkation of rescued survivors on-board their vessels when possible and a number of other supportive actions in relation to the operation."[28] Furthermore, the latter can be dealt with by making "…proper adjustment or an exemption of Autonomous ships from the Search and Rescue operations…"[29] This alternative is displayed as "the most appropriate solution"[30]. However, A. Komianos also raises attention to the fact that "an exemption of ANY kind of vessel at sea from the SAR involvement and obligations, may raise the concern of seafarers with respect to how the shipping industry, various regulatory bodies, and relative organizations regard the rescue of their lives at sea."

Briefly summarized "The Autonomous Shipping Era. Operational, Regulatory, and Quality Challenges" the main emphasis is the need for a review of all the relevant regulatory, operational and quality assurance framework also, with regards to ethical concerns. However, it needs to be considered "the perspective of future requirements increasing the overall structural costs, potentially minimizing the economic benefits of a crewless vessel."[31]

[27] A. Komianos

[28] A. Komianos

[29] A. Komianos

[30] A. Komianos

[31] A. Komianos

The production of unmanned vessels and its legal implications in the maritime industry. By: candidate 557161, UIO, faculty of Law (2014)

The following article was written in order to examine if unmanned vessels comply with key central regulations of the present legal framework.[32] It presents arguments and reasons for and against before a final conclusion on whether they need the need to be amended and updated in order to regulate this type of ship. With regards to SAR, one of the main problems of the article is that an autonomous vessel has severe implications from the safety point of view that will be further elaborated on. The latter is also mentioned as one of the maritime industries main concern.

As previously mentioned SOLAS V/33 clearly establishes a "general principle to every ship where masters have the duty of responding to information of any source about persons in distress at sea."[33] and "Once rescued, persons must be treated in a humane way and must be delivered to a safe place."[34] The article states that there is an evident question regarding this; "how would the rules and exceptions of this regulation apply to unmanned vessels?" Two hypotheses on how to comply with this are established by the author:

The first hypothesis is to exempt autonomous vessels based on practical reasoning. As the designs of today stand, there have been no attempts to accommodate for assisting a vessel or person in distress. Furthermore, SOLAS V/33 statement regarding "humane treatment" cannot possibly be fulfilled unless minimum requirements are established.

The second hypothesis indicates that IMO has to produce legislative requirements in order to make autonomous vessels comply with the traditional expectations of securing lives at sea. The reasoning goes that if technology has come as far as unmanned ships, there is no reason for not applying the same resources into developing a system that can manage SAR.

[32] candidate 557161, UIO, faculty of Law (2014)

[33] candidate 557161, UIO, faculty of Law (2014)

[34] candidate 557161, UIO, faculty of Law (2014)

Summary of the literature review

The literature presented brought up various judicial and ethical challenges regarding MASS and SAR operations. The authors all based their articles on MASS, presenting obvious legislative challenges. However, their perspectives varied on how to attend to them. Whether it has to be dealt with through interpretations, exemptions or minimum requirements, there was a consensus that the legislations of today does not accommodate for MASS adequately. However, this bachelor thesis wishes to advocate one important concern; with regards to the articles chosen the opinion of those who DOES NOT think that MASS presents legislative SAR concerns are not accounted for in the literature review. The latter stems from the fact that the research could not produce an article that speaks for those that see no issues with the legislation. Furthermore, there is also the concern that law, unless deemed controversial, seldom has people who agree with voice their opinion. The latter could potentially suggest that the authors of the literature review might be voicing the opinion of the minority in the maritime industry.

3 METHOD

In the following chapter, we will explain the use of the qualitative method as part of this research project. The methodology chapter contains a justification over choices of method and a reflection on the relevance, reliability and validity of the research method. An account is given of how units are chosen, questions are formed, and how choices along the way have influenced the outcome of the interview process and the validity and reliability of the project. Methodologically reflections illustrate how selection has influenced the answers.

3.1 Methodological approach

The methodological approach of this bachelor thesis is to address a theoretical research question founded in the course subjects' maritime law and risk management. An explorative approach answering the research question proved to be beneficial in solving issues on a theoretical level as a limited number of publications, and established theory was available. Definitions on autonomy are currently being used differently across organisations and jurisdictions, and the SAR issues with autonomous ships have yet not been defined by the various regulatory bodies. Through explorative research, we aim to highlight important issues from the perspectives of some key actors involved.

An abductive approach has been chosen as the theory of science, as we are continually moving between theory and empiricism. This approach is suited when the theoretical basis is adjusted as empirical data is collected, and the data acquisition will change gradually as new theories are developed[35]. When developing new hypotheses and theories, a qualitative approach to the collection of data was favourable and well suited as the research method emphasises insight and seeks understanding[36] by using a fluid operational structure. This methodological approach helped define the thesis question more precisely, by adapting relevant theory when new insight was gathered over the interviews.

[35]. Busch, T. (2013) s. 51

[36] Tjora, A (2017) s. 16

3.2 Collection of data

The data was collected by interviewing an expert panel in the field of autonomy and law. The participants were selected based on their working experience in relation to autonomy and educational background. In total, six interviews were carried out, of which four were held in-person, and two over a phone call and Skype. Of the six interviews, five participants accepted the interview being recorded on an audio file. The audio files and notes from the interviews were later transcribed and coded. Information about the interviewee's views and interpretations of existing regulations and challenges related to MASS and rescue services at sea was the main focus of the interview. The timeframe of the interviews were approximately 30 to 60 minutes.

Sample selection and contact

The methods for sample selection was recruiting based on internal recruitment of experts within DNV GL and through the literature review. The literature review analysis identified various authors who have promoted and discussed similar issues in recognised publications on the topic of autonomous ships. The first contact was attempted by telephone, and then an e-mail was sent containing information on the topic, the problem and an invitation and request for a personal interview.

The primary criteria for the sample were leading people in their field within autonomy with a background in law, risk management or technology. Notably, individuals with hands-on expertise and experience on the topic of autonomous ships were chosen. After conducting interviews with engineers and lawyers, we found it necessary to extend our sample criteria to include individuals with seafarer experience. This choice is justified in highlighting the ethical dimension of the thesis. A wider variety of sample backgrounds give more valuable reflections on the topic. Representatives from the Norwegian Maritime Authority (NMA), DNV GL, the Scandinavian Institute of Maritime Law and the National University of Singapore participated in the project. Educational backgrounds are ranging from lawyers, engineers, master mariners and physicists, with an age span from 26 to 78. A total of six industry representatives have participated in the project. The following table displays the expertise involved.

Table 2 - Participants Expertise and Background

Educational and professional background
LL.M. and MA Politics. Researcher at the Centre of Maritime Law, National University of Singapore. Currently undertaking a project that examines the future legal opportunities and challenges presented by the use of automated technology and unmanned vessels in international shipping.
MSc. Cybernetics. Experience from working on projects on autonomy, automation and other new technology, as well as regulatory development in the Norwegian Maritime Authority.
Certified Master Mariner with over ten years' experience as a deck officer at sea. MSc. Management of Demanding Marine Operations and MSc. Technical Maritime Management. Expert on ship operations and navigation.
LL.M. Expert in Maritime Law and Insurance, representant in the Norwegian Ship Security Board (*Skipssikkerhetsutvalget)* practised as arbitrator and professor at the Scandinavian Institute of Maritime Law, University of Oslo.
Expert on autonomous ships. Project manager for the development of DNV GL's rules and guidance within this area. Participated in several initiatives and (research) projects regarding autonomous ships. Background in Telecom and Software.
PhD, Theoretical Physics. Experience from the research division of DNV GL, representant in the IMO and author of about 60 IMO submissions. Working on a regulatory review for autonomous ships and contributor in the introduction of the Regulatory Scoping Exercises on MASS held by the IMO.

Interview process

The main purpose of the interview was to create a situation for a relatively free conversation about predefined topics. Before the completion of personal interviews, an interview guide was composed to help structure the interview and narrow the scope of the thesis. Broadly speaking, the interview guide goes through three stages; introduction questions, reflective questions, and rounding off questions. The introduction questions

are composed to help a sense of confidence and mastery for the participant[37]. In this section, the research project and thesis questioned were presented, followed up by questions mapping the participants' background and working experience in relation to MASS.

When preparing the reflection questions in the interview guide, we focused on the relevant issues that surfaced in the literature review and decided to study further some specific regulations and topics. The relevant regulations that were discussed in multiple publications were SOLAS V/33 and UNCLOS Article 98. The authors of the articles did not agree on the way of interpreting these regulations. Different ways of interpreting those specific and very relevant regulations in terms of SAR raised new questions regarding the definition of the master, a possible exemption from the legislation and multiple ethical dilemmas. These themes ended up being central in the preparation of the interview guide. As they were already promoted as possible challenges, we wanted to investigate this further asking our expert panel.

The interview guide was based on the named topics. Relevant questions were divided into the predefined dimensions of the thesis; judicial and ethical issues related to SAR. We decided to include one question about the risk-aspect but emphasised the judicial and ethical dimensions. In order to direct the conversation away from the technology aspect, the focus on risk was limited, as it often turned the conversation into technology-based discussions. The interview guide includes four reflective questions on the identification of judicial and ethical SAR challenges which was asked all participants. Follow-up questions on the interpretation of specific paragraphs and personal thoughts on predefined scenarios were asked dependent on the tone of the conversation and the background of the interviewee.

The interview

All the interviewees were invited to participate in the project by e-mail. Before the interview, participants were informed about the project topic, research questions and the aim of the interview. A shortened version of the interview guide, along with a consent document, was later sent out just before the interview date for the participants to prepare

[37] Tjora, A (2017) S. 146

and review the relevant regulations of the thesis focus. The project and research method have been submitted and approved by the Norwegian Centre for Research Data, with reference number 649378. The full interview guide can be reviewed in Appendix A below.

3.3 Method of analysis

The interviews were transcribed and coded. Transcription of interviews is a necessary procedure in order to analyse the conversation[38]. We were aware that the process of transcription left us with reduced reproductions that were no longer in its original context when handling the raw material[39].

The method of analysis is based on the step by step, deductive-inductive method, as presented by Tjora[40]. By using this model, the work between the collection of raw data and the development of theories were divided into stages, moving from own empirical data to new theory. After generating empirical data and processing raw data, in the form of text documents, an inductive empirical coding of the transcribed interviews were conducted. This involved coding all the data, with the aim of extracting the essence, compressing the material size and facilitate for the generating of ideas based on the details[41]. When all six interviews were coded, which in this project is the main data material used in the analysis, we ended up with a list of inductively generated codes based on the analysis documents. Seven key themes were identified;

- The driving forces
- Interpretation of SOLAS V/33
- Definition of master
- Exemption from the legislation
- Jurisdiction area
- The collision between MASS and a conventional vessel

[38] Kvale & Brinkmann (2015) s. 204

[39] Kvale & Brinkmann (2015) s. 206

[40] Tjora, A (2017) s. 18-19)

[41] Tjora, A (2017) s. 197

- Moral code

Each theme was examined to gain an understanding of participants' perceptions and motivations.

Validity and reliability

In qualitative research, the terms validity and reliability are used as criteria for quality. The validity is about the research's' legitimacy and relevance and is often used as a tool to validate that what we measure in the research is what we are meant to measure[42]. As the aim of the bachelor thesis was to identify judicial and ethical challenges for MASS in relation to SAR, the validity of the research can be evaluated by the chosen sample section in terms of qualifications and background, and whether the bachelor thesis did identify the challenges defined in the research question. When researching a phenomenon, it is unlikely only to get results that are completely valid to the research question. This is also the case for this bachelor thesis. Regardless, the empirical findings did indeed identify judicial and ethical challenges in a nuanced way. However, we also decided to address what we identified as an underlying cause for some of these challenges, with the aim to lift the discussion to a higher level.

In the stage of concept development, in the SDI-model, we aimed to present findings through categories that were supported by theoretical perspectives and previous research presented in the literature review. The theoretical perspectives were validated through our own empiricism, but often in a different context and with a greater distinction between our participants' opinions. By presenting these categories supported by theoretical perspectives and previous research, the concepts were not only linked to our empiricism, which could contribute to a higher level of validity[43].

Reliability is about whether the data collected is durable, accurate and reliable[44]. Being able to rely on the research data is, therefore, a criterion for the study's reliability. Other important factors that influence the reliability are whether the concepts and phenomena's one wishes to investigate are measured in similar situations and how precisely they are measured. In this bachelor thesis, the reliability largely depends on

[42] Larsen, A. K (2017) s. 45

[43] Tjora, A (2017) s. 245

[44] Larsen, A. K (2017) s. 47

whether the interview transcripts reflect on what the participants expressed in the interviews. We have been careful in this process and emphasized on including everything that was mentioned during the interview, regardless of what we considered relevant for the analysis. In that way, we aimed to preserve the reliability of the interview data. We consider the reliability of the interview not being recorded partially impaired, as we were only able to note down the main essence and certain points from the conversation and might have missed relevant aspects from this interview in the analysing process.

Finally, it is also worth mentioning that some interviewees might have been careful to make specific statements on certain topics, as they are linked to prominent actors in the development of MASS. This could potentially affect the extremities of the discussion in the analysis and the reliability of the analysis.

4 ANALYSIS AND DISCUSSION

In the analysis and discussion chapter, the findings of the analysis will be discussed empirically. The findings will be structured as a review of what the interviewees said about a certain topic with a discussion ensuing both during, and as a summary of each topic.

With MASS being a very new and technology-dependent concept, it quickly became clear that the interviews conducted would vary extensively in terms of the approach towards SAR and the legislation. The questions were discussed with very different perspectives, usually dependent on the interviewees' background and experience. In order to address this, the first topic of the following chapter will present what the interviewees' perception of the main driving forces behind MASS and how well prepared the different legislative bodies are.

With regards to the purpose of the bachelor thesis, the analysis will attempt to showcase further and more thorough discussions on the matters brought up in the literature review. This part will be recognized as the main findings. The latter being the *role of the master*, *the interpretation of SOLAS V/33*, *exemptions from SAR obligations* and *the moral code at sea.* There were also potential challenges that were not brought up in the literature review but was mentioned by several of the interviewees. These being *jurisdiction area* and *collision between MASS and a conventional vessel.* The last topic of discussion will be the main issue that emerged as a red string when the interviews were looked at as a whole.

4.1 The driving forces of MASS development

The participants all have different viewpoints on what the driving forces of MASS development are. However, no one mentions traditional shipowners and mariners as actors in the push for autonomy. As cited in the introduction to the analysis, this subchapter does not directly respond to the research question in terms of identifying SAR challenges. Nonetheless, the different viewpoints on this matter proved interesting in displaying the context of where the opinions in the analysis derived from.

"Change is likely to come from cargo interests rather than the actual industry itself". Land-based logistics players such as the Norwegian chemical company Yara and the grocery wholesaler and logistics company ASKO are brought up as examples of cargo

interests that push for autonomy by two of the participants. These are examples of spearhead projects that are working towards fully autonomous operation with the cooperation between land-based logistics players and the international technology group Kongsberg. Participant 5 stated that the process will happen gradually function by function and that the spearhead projects mostly seems like PR. He substantiates this claim with that the leap to fully autonomous shipping is considered so great that one cannot take away the human aspect this early in the development.

“There are governments preparing for it, rather than the industries”. Governments, legal professionals and insurance companies are brought up as development drivers by four participants. Whereof two, both mentioned The Norwegian Maritime Authority, DNV GL and insurance company Gard as important contributors that have been devoting resources to try to facilitate for the progress and development of MASS. It was appointed by one interviewee that domestic legislation might well start the driving of how the international conventions are amended, as the governments involved are main players in the IMO as well. The involvement of domestic governments and legal authorities were pointed out as fundamental in the process of reaching an international agreement. Ironically, some participants claimed that the government might even be a step ahead of the actual development.

"My feelings are that the industry is not really that engaged with it". Why aren’t the traditional shipowners more involved? “In general, the maritime industry is quite conservative, and I have to say that a lot of the initiative on autonomy comes from other groups than necessarily the traditional shipowners.” The Maersk statement from CEO Søren Skou, saying that it is unlikely that their container vessels will operate without humans in his lifetime and that it is neither hugely interesting for them, is exemplified by a participant as a sort of a push back from that part of the industry. That being said, the same participant elaborated on that traditional shipowners are not known to drive change anyway traditionally. For shipowner’s autonomy is expensive, the regulatory framework is unclear, insurance aspects are unclear, and the fact is that the crew today is cheap. A different interviewee agrees with the maritime industry generally being conservative but continue stating that one must not forget that several shipping companies are constantly researching on the possibilities of automating more and more

functions on board even though it may not be with the aim of going totally unmanned in that sense.

4.2 Regulatory SAR Challenges

This chapter will break down the themes and emerging challenges connected to SAR and MASS operations that appeared in the conducted interviews. Each challenge/theme will be analysed based on the participants' viewpoints and then discussed. The following table attempts to outline the main findings and give an overview of the following discussions. Some of the main findings were strongly connected to either the judicial or ethical challenge. However, the discussion on a possible exemption from the legislation and the scenario of a collision between MASS and a conventional vessel both posed major judicial and ethical challenges.

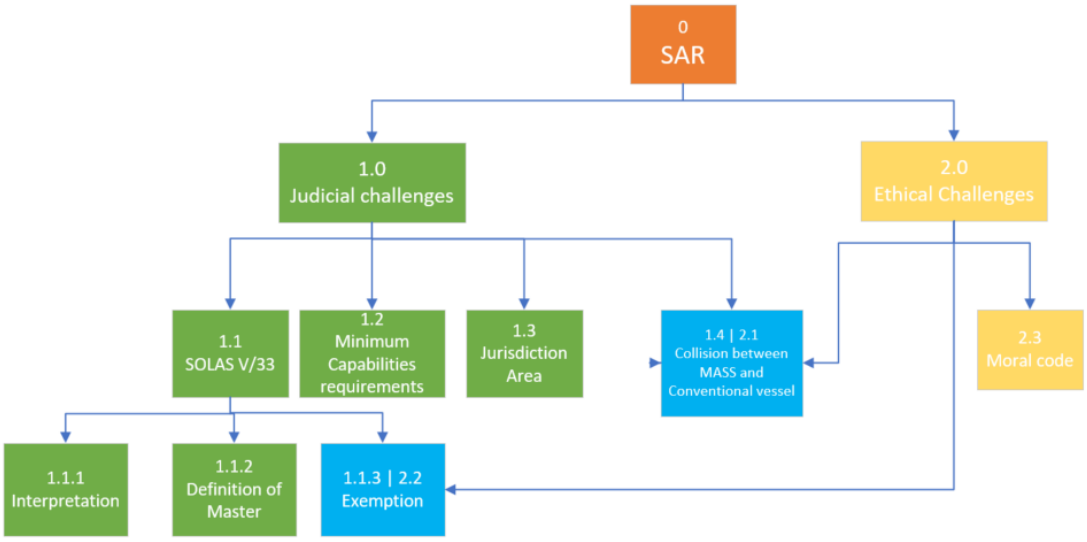


Figure 1 - Trail of discussion

4.2.1 SOLAS V/33

The ensuing subchapters are based directly on the interviewee's answers regarding SOLAS and MASS operations. The latter being a large part of the basis of which this bachelor thesis is built upon. It has been broken down into three main topics in order to display different opinions more effectively.

4.2.1.1 Interpretation of SOLAS V/33

In the literature review the article "All hands off deck, The legal barriers to Autonomous vessels" the author brought up the possibility of the master of MASS interpreting SOLAS V/33 as not related to her/his vessel since the phrasing states that "The master of a ship at sea which is in a position to be able to provide assistance…" could be argued for not applying to an unmanned vessel. Additionally, SOLAS V/33 section 6 states that the vessel must act "…within the capabilities and limitations of the ship" in a SAR situation. With the latter in mind, the interviewees were asked how they would interpret this regulation.

The answers varied extensively. In hindsight, the question was presented in different contexts in each interview. This could potentially have been a reason for the lack of a consensus regarding the topic. However, the interviewees' interpretation of how to address the question raised some interesting aspects. First off, there was the perspective of the sentence "in a position to…" potentially referring to the geographical position of the ship. In that case, the phrasing would not raise any questions revolving whether this would cover autonomous vessels, with no people on board, adequately. Furthermore, there were extensive agreements on "…within the capabilities and limitations of the ship" not raising any regulatory challenges either. The latter was explained with the fact that comprehensively from a judicial standpoint the law says, "within the capabilities" and having no capability can also judicially be defined as a capability.

Only one of the interviewees saw clear flaws in how regulation 33 covered the aspect of SAR and MASS. The fact that "within the capabilities" could potentially be giving MASS exemptions from the duty to render assistance is a clear regulatory issue. After all, the law must be interpreted not just by the phrasing, but also by its purpose. As mentioned in the background chapter, the moral code of securing lives at sea was the reason behind the creation of SOLAS. Initially, the interviewee could not see how a word by word interpretation would be enough basis to pass a verdict in a courtroom.

When presented solely in its literal form, SOLAS V/33 does cover the aspect of autonomous vessels. There was a unilateral agreement on the phrasing not causing any judicial challenges when interpreted this way. However, overall the judicial challenges raised by the interpretation of SOLAS chapter 5 reg 33 does not stem from a general

perception of insufficient coverage in the way that it is pronounced today. The main challenge comes from the fact that the interviewees seem to disagree on whether the law itself has to be re-worked in order to serve its purpose.

4.2.1.2 Definition of Master

Concerning SAR operations, one of the main regulatory challenges that surfaced over the interviews referred to the definition of Master. The master definition, and more specifically, the role of the Master is directly linked to the responsibility of carrying out SAR operations and can be held criminally liable for not providing this duty as proved in the “Bow Eagle” incident mentioned in the background chapter. On conventional vessels, this role has traditionally been linked to the captain who holds the responsibility and the highest rank on a ship. The role has always been central in terms of accountability because it in practice has functioned as an extension from the shipping company during a voyage. Traditionally, this was because the shipowners were more distant and inaccessible to be able to make decisions when a ship was sailing from A to B.

There is an agreement among the interviewees that not having a defined master pose multiple judicial challenges. One interviewee expressed that; "We will have to find whom they would consider being the master because currently the master is directly responsible for SAR decisions and could also be prosecuted for not undertaking SAR”. The role must be fulfilled and defined in order to comply with current regulations. This is where people in the industry are uncertain about what will become the new standard.

All interviewees agreed that in order to achieve MASS operations concerning the judicial framework, the role of Master must be able to be placed in another location than on the actual ship. In the scenarios discussed, a possible solution proposed by four interviewees was that this location would most likely be in a remote-control centre on land and that the master title would be held by a shore-based operator (SBO). One interviewee addressed this by saying; “Until you possibly change the rules, I think the master should be the one who is on land, in operational charge of the ship” However, this proposed solution was not the consensus among the interviewee’s responses.

If the master role would be delegated to one superior person in the remote-controlled centre as proposed by the above interviewees, new issues regarding accountability will have to be addressed; “Evaluating the aspect of a shore control centre, there will likely be shift changes, so you will not have one person, you will have multiple people watching that ship on its voyage. So, who makes a decision at what point? That is going to be the challenge”. Devoting the title and responsibilities to a vicarious person in charge at the remote-control centre that changes along with shift hours will give a destitute overview of who has the accountability and which of the “masters” during a voyage can be held criminally liable if a situation occurs. Five interviewees mentioned this possible fundamental change from having one constant master, that is always available on the voyage, to perhaps having the master change several times during a voyage and overseeing multiple ships at once as a judicial challenge. This issue was also raised by Luci Carey in her article All Hands, Off Deck? The Legal Barriers to Autonomous Ships (2017), as mentioned in the literature review.

In terms of accountability, three of the interviewees pointed a higher degree of liability in connection with the master role back to the shipowner. Tracing the primary responsibility of the role back to the accountability that the master position holds, placing the master responsibilities on an SBO working in a remote-control centre drastically changes the framework for the job that is being done. Especially in the terms that the master SBO will not have the same degree of independence and could be much more subject to the shipowner and the shipping company. With a remote-control centre, the shipowner and shipping company potentially have access to the same resources available as the delegated Master in terms of accessibility from afar. Considering this aspect, the shipping company will always be a responsible party. One of the interviewees expressed that “If the shore control centre does not provide SAR services, then we are going to go directly to the owner and hold them directly liable for that”. This viewpoint showcased the extremity of the different opinions, but many of the interviewees agreed on that the shipowner should hold a higher degree of liability than what they hold today. MASS being system-based was another reason mentioned by a different interviewee.

The study participants disagreed on whether the Master role should be reconsidered and rewritten, or if it is more favourable to keep the traditional role and responsibilities of the Master. The judicial challenge is that there was a missing consensus among the participants on how to agree on a procedure of applying the Master role to MASS operations.

Finally, the main SAR challenge in relation to the master is deciding on who is to be held criminally responsible for not providing the duty of SAR. This poses a judicial challenge as today's role of the Master is directly linked to the responsibility of carrying out SAR operations. All interviewees agreed that in order to achieve MASS operations concerning the judicial framework, the role of Master must be able to be placed in another location. However, there was not a consensus on what party that would end up being responsible in the future scenario. The surfaced viewpoints have been discussed, but this is undoubtedly an area which needs to be addressed further.

4.2.1.3 Exemption from legislation

As mentioned in both the background chapter and the literature review, there have been discussions of making exemptions in the legislation for MASS operations. In the paper "The production of unmanned vessels and its legal implications in the maritime industry" the author introduced two hypotheses on how to make MASS comply with the legislation. The first one of those hypotheses were exempting MASS from the legislation based solely on practical reasons. "As the designs of today stands there has been no attempts to accommodate for assisting a vessel or person in distress"[45]. The interviewees were all asked to give their opinions on the matter, especially with concerns to SAR. It was also made clear that outside the designated testing areas, there has not been made an exemption from the international conventions as of today.

The majority of the interviewees had the general opinion of an exemption being unrealistic. However, the reasoning for this varied significantly.

Two of the interviewees saw the concept of an exemption as an ethical challenge more than a judicial one. The latter because exemptions are not challenging to make with regards to a judicial phrasing stating that certain vessels are not obligated to assist in

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SAR. Reiteratively, as discussed in “Interpretation”, the same interviewee brought to attention that laws and jurisdiction cannot just be interpreted word by word. The purpose of the law itself has to be accounted for, and if the purpose of exempting MASS is solely done to make the current legislation less challenging to enforce, then this raises an ethical challenge. Overall the latter interviewee saw the judicial challenge mainly as the discussion of whether it is unjust to put more of a burden on a manned ship than an unmanned one with regards to SAR.

There was also the opinion of exemptions being unrealistic based on the fact that the interviewees could not see any cases of exemptions of this scale having been made before. Also, there was the point of emphasis that no matter the rescue capabilities of a ship, it would always be able to assist with the search. The practical reasoning for an exemption in the hypotheses made in the literature review became non-applicable if the arguments of search capabilities became a consensus. The latter was also addressed by the master mariner who saw autonomous vessels as more of an opportunity than a problem with regards to SAR. This will be further elaborated on in the following sections.

In contrast to the opinions stated in the sections above, there were opinions of the legislation being interpreted and developed with “quid pro quo” in mind. The fact of the matter is that an unmanned ship does not put its own crew in any risk at sea, so then why should they be obligated to account for other ships having a crew at risk. The latter was an opinion shared among several of the interviewees, one of them even stated that there was not really a point in making an exemption due to the legislation already of giving MASS an exemption if interpreted word by word. Once more, the challenge of a lack of an ethical discussion on the purpose of the law or the purpose of an exemption to the law became clearer.

The most interesting perspective with relation to exemptions from the legislation came from the Master Mariner. Being the only interviewee with significant experience at sea and with SAR situations, the master mariner brought a very different perspective to the table; “Unmanned vessels must be able and obligated to contribute to SAR. A ship being unmanned could be more of an opportunity than a handicap since a

master/shipowner would not put any of his own crew at risk by assisting in SAR."[46] The latter being stressed as usually a major point of concern, especially in situations involving storms and bad weather. With regards to both the interpretation and a possible exemption the master mariner went as far as to claim that no seamen would ever take the role of a master of a ship that would not have SAR as an "in company policy". Seamen's moral code of assisting others is deeply embedded. As mentioned in the case of "Bow Eagle", to continue sailing while someone is in distress would be morally judged with the same ramifications as taking someone's life. The master mariner exemplified this with the following sentence; "would you walk past an injured person without helping and justifying it by not being thought first aid?"[47]

4.2.2 Defined sea area

The topic and challenges surrounding possible jurisdiction areas and the difference between MASS operation in a domestic area vs internationally was not discovered in our literature review but were a topic that was raised as a judicial challenge by multiple interviewees. It became evident that one must reconsider the current regulations, as not necessarily globally applicable but more area-based.

When asking about a vessels responsibility of conducting SAR, it was early established that this dilemma had to be discussed in different contexts and scenarios. The discussion can be divided into two different parts:

- Jurisdiction area in the context of which court will be able to prosecute a criminally liable party considering that a MASS operation can be divided between three jurisdictions.
- Area-based, considered by vessel density and traffic situation.

It is evident that the operation of MASS internationally will pose a greater challenge than in national waters, with the close following and cooperation with national authorities. One interviewee expressed that "We will have to distinguish between national and international traffic in relation to what could be expected for SAR". This was supported by all participants who agreed that we must consider the difference

[46] Master Mariner

[47] Master Mariner

between deep-sea routes and domestic high traffic sea areas to a greater extent than today. Preparing these adjustments into the current legislation will pose a judicial challenge and ships must relate much more to the area in which the ship is to sail.

According to two of the interviewees, for the legislation not to be too restrictive, the operating area should be considered according to vessel density. The ASKO/Kongsberg project on MASS ferry drones[48] which are set to operate between Moss and Horten was used as an example.

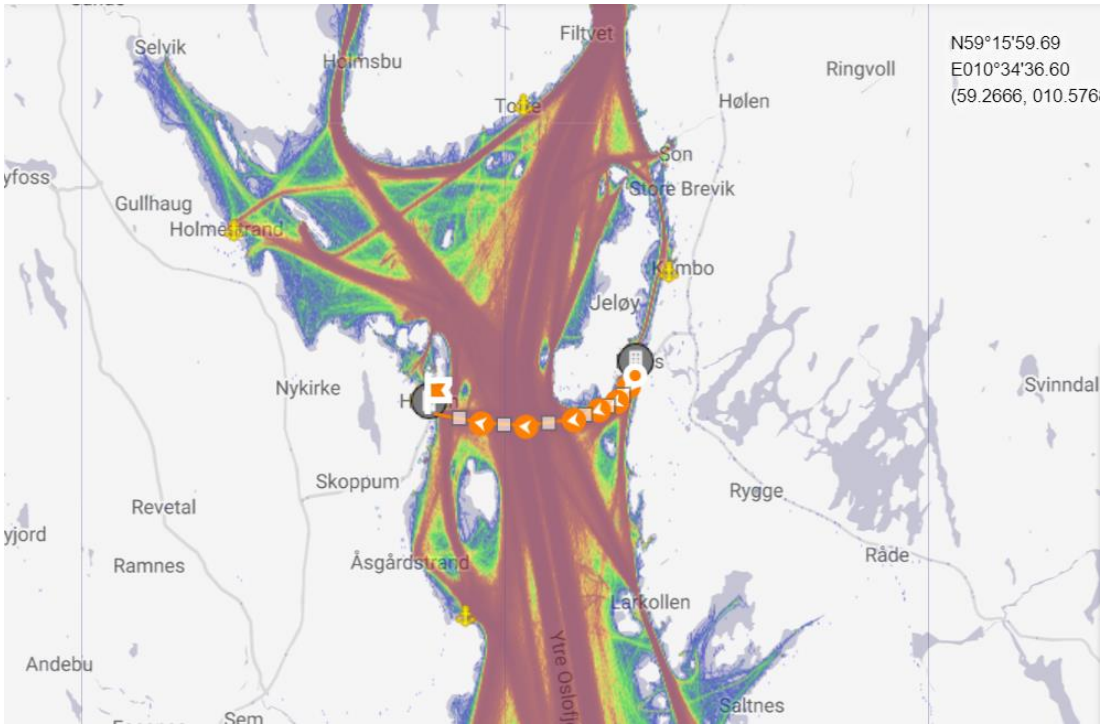

Figure 2: - Domestic route between Moss and Horten Source: Marine Traffic

The same interviewees emphasised that this route and other operational areas in Norwegian fjords have a high-density of vessels, so there will always be available vessels in relatively close proximity that can assist. This could therefore possibly justify an exemption from the legislation on providing SAR or at least lighten the responsibility. All vessels should be able to assist in some way, but in domestic high vessel density areas, all interviewees agreed that assisting by contributing to the search or not being capable at all should be acceptable.

[48] Tu.no. (2019)

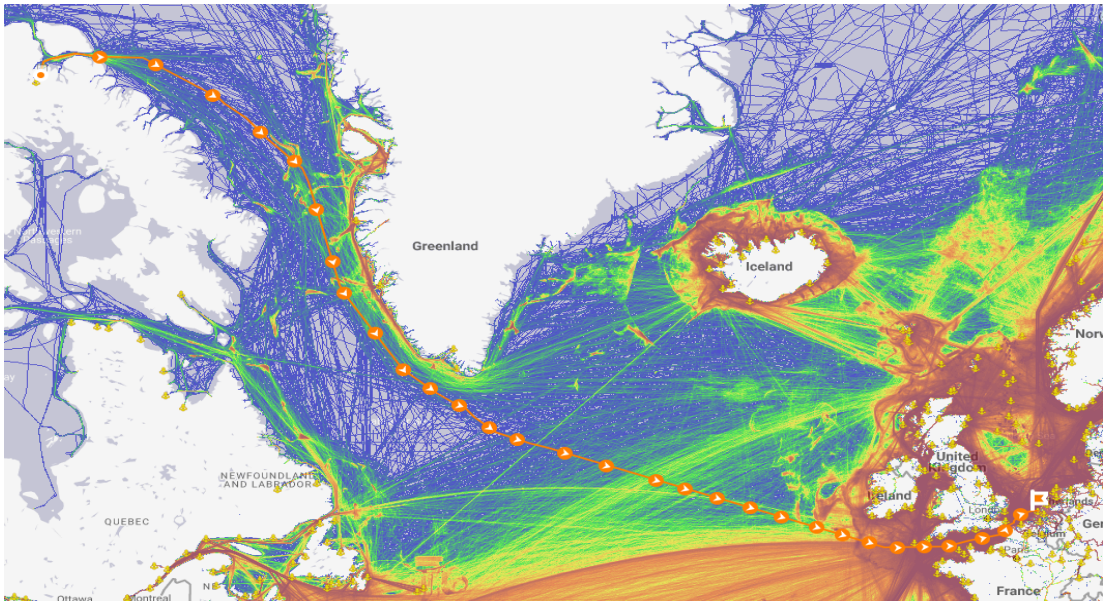

Figure 3: – Route between Rotterdam – Milne Inlet. Source: Marine Traffic

The above-illustrated route demonstrates a very different scenario which three of the interviewees commented that would pose greater challenges than domestic routes. *"I think, MASS are only going to operate in non-territorial waters unless there is a bilateral agreement between two countries to allow them to operate"* claimed one interviewee. Deep-sea operation opens a completely different discussion which must be addressed further. SOLAS applies regardless of territorial waters, but these scenarios strongly emphasise the ethical challenges where a MASS is the only available ship. All participants seemed to distinguish the need for SAR compliance MASS ships in a domestic route, and a deep-sea, cross Atlantic like the one between Rotterdam and Milne Inlet.

Finally, it is also important to consider the legal challenge of moving from one jurisdiction area as a one-dimensional discussion with conventional vessels to a two or three-dimensional jurisdiction case for MASS. The three possible jurisdictions, identified by an interviewee, as a flag state, the location of the remote-control centre/ where the vessel is operated from, and the actual ship placement will have to be addressed further especially with regards to SAR.

4.2.3 Collision between MASS and a conventional vessel

During the course of our interviews, one specific scenario surfaced that had not been reviewed or accounted for in the background or literature review. The scenario goes as follows: “A MASS vessel is at fault for having collided with a conventional vessel, and people are in the water and in need of immediate assistance” The scenario pinpoints the essence of what has surfaced during the previous discussions. It was a question that designated itself for making the interviewees pause and think. Some even went as far as to say the question is difficult to answer.

If the said scenario was to occur, there are clear breaches in the ethical reasoning for not being able to assist the people in distress competently. The argument of quid pro quo; “MASS is not putting people in danger, so why should they account for other vessels putting people in danger” cannot be applied in this scenario. When presented with the latter, the consensus among the remaining interviewees was that, if not an actual judicial challenge, the scenario was really pushing the boundaries of how far one can go in ways of interpreting the law from an ethical perspective.

A few of the interviewees brought up UNCLOS Article 98 in order to address the question more thoroughly. UNCLOS Article 98 (c) states that “after a collision, to render assistance to the other ship, its crew and its passengers and, where possible, to inform the other ship of the name of his own ship, its port of registry and the nearest port at which it will call.” The point of emphasis is that there are minimum requirements for all commercial ships (<24 meters LoA) requiring them to have rescue equipment to secure all lives on board the vessel. Therefore, every manned ship (<24 LoA) has an ability to render assistance in some way or the other. However, in the case of an unmanned vessel, there potentially would not be any rescue equipment due to not having any lives to secure. With the latter in mind, a MASS could potentially not provide any actual assistance after being at fault for having collided with a vessel, and there would not be any obligations for them to do it either.

The judicial and ethical challenge apparent from the following scenario can be traced back to the second hypothesis made in the article “The production of unmanned vessels and its legal implications in the maritime industry”. The hypothesis states that “IMO has to produce legislative requirements in order to make autonomous vessels comply with

the traditional expectations of securing lives at sea. The reasoning goes that if technology has come as far as unmanned ships, there is no reason for not applying the same resources into developing a system that can manage SAR."[49] The latter will be a way off addressing the issue of MASS having no ability to assist. However, making a legislative body at the scale of IMO engage with completely new regulations can be a challenge in itself.

In the case of "collision between MASS and a conventional vessel" what was brought up was the need for legislation in which would hold MASS accountable for fulfilling certain technical requirements. The requirements of navigation and watchkeeping to rescuing equipment and collision detection. Anew the underlining of making laws that would serve the purpose of upholding the ethics and moral at sea was stressed. The legislation was originally written to accomplish this, but the main judicial challenge comes from the fact that the idea of having an unmanned ship was not accounted for.

4.2.4 Moral Code

As discussed in the previous sub-chapters; "Interpretation and exemption of SOLAS V/33" and "Collision between MASS and a conventional ship" it is proven that MASS and SAR situations can challenge the moral code at sea. This chapter will further elaborate on the interviewees' thoughts about the maritime industry's' attitude towards securing lives at sea and how this could be affected by MASS.

One of the first questions asked with regards to the moral code and MASS was how people with two very different work environments are expected to follow the same ethical guidelines when being distanced from the scene by working in an RCC. Could this be an ethical challenge in relation to MASS?

There were two aspects arising with relation to the distancing. On the one hand, being in an RCC means having closer contact with the shipowners, and possibly a broader overview of the situation. This could result in masters making less irrational attempts at rescuing with a feeling that "We must go there too!" as one interviewee stated. The threshold for helping might also be lowered as there is now a less personal risk in

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participating in a rescue operation[50]. Some were also mentioning that the distancing can lead to a generally more analytical, and thorough reaction to SAR as the situational pressure is less.

On the other hand, there was the perspective of a scenario of which MASS is involved in causing the need for SAR, while operators in the RCC are occupied with other vessels, experiencing alarm fatigue or generally being distracted. The "Bow Eagle" incident exemplifies this challenge in some way, by the master being absent from the bridge and the crew agreeing on "not speaking about it". The raised concern by the Master Mariner was that being distanced from the situation could make it easier for the operator to distance themselves from the responsibility. This could be due to the fact that the main purpose of the operator is to surveillance and only interfere when asked so by the system. In that sense, by not being on the sea, and not making every decision themselves, they might not feel the same responsibility.

The argument behind "quid pro quo" was also brought up in an ethical context with regards to the moral code. "Should MASS really have obligations to a manned ship when it is not manned itself and will not be in a position where it acquires SAR". The interviewee with a significant legislative background saw this as a weak argument, not just judicially but also ethically. Furthermore, the last-mentioned interviewee claimed that the "quid pro quo" argument is a way for the "technology optimistic engineers" to dodge the ethical questions by saying that because there is no obligation towards their vessel, it has no obligations to anybody else.

The Master Mariner was surprised that the "quid pro quo" argument even exists on this matter. At sea, the fact is that all vessels do not have the same ability to help each other. The Master Mariner put it into the perspective of; "a small fishing boat could never offer help to a passenger ferry, like the other way around. However, this does not make the master of a passenger ferry feel less of a moral duty to assist the smaller vessel."

With regards to the moral code, there was also the perspective of the maritime industry's attitude towards securing lives at sea has changed in recent time. The main point being that; It is unclear whether MASS in SAR situations will cause a moral

[50] Master Mariner

concern for the shipowners. “The moral and judicial duties that SOLAS state are less solemn today than they were at the time of their creation.” Putting it bluntly, some interviewees expressed that the fact that we have launched the idea of MASS at all, clearly proves that we are moving in the direction of securing lives at sea being less of an issue. Or at least that the duty is taken less solemnly than before. The gap between some of the participants' opinions, concerning where the moral code stands, poses a considerable ethical challenge.

4.3 The Gap

In the literature review, A. Komianos (2018) mentions that there is likely to be two perspectives in the approach to MASS and the SAR related legislation: The first being the perspective of future requirements potentially inhibiting the potential of MASS by making the necessary legislative requirements to accommodate for SAR situations too costly. However, this could open up for a scenario in which shipowners themselves could be deciding on how to comply with SAR. This brings up a second perspective; Exemptions and requirements, or the lack thereof, might raise the concern of seafarers with their regards to the industry securing their lives at sea.[51]

After having conducted all the interviews and analysing the participants' views and opinions, there was one larger overall challenge emerging. As mentioned in the section above, the two different perspectives in the approach to MASS and SAR related regulations created a clear gap between the person at sea and the people on land. Simply put, there was a dissonance on the ethical and moral matters that SOLAS/UNCLOS attempts to uphold legislatively. Throughout the analysis and discussions, matters that were thought of as self-explanatory to the master mariner were viewed as debatable evaluations by others. A great example of this is the discussion of the moral code and the “quid pro quo” argument.

Some of the interviewees also referred to MASS as a concept containing traces of “technology positivism”. A cooperative approach to reworking the legislation has taken a “backseat” as all the tremendous opportunities that MASS could bring has mainly

[51] A. Komianos (2018)

been the emphasis. This could perhaps also be one of the reasons for Yara Birkeland not having been launched at sea yet. As a cause of this, there is an actual concern regarding the fact that the maritime industry might be having a post-active approach to SAR and MASS operations. In simple terms, the legislation awaits a practical example of which to develop suitable laws. When asked whether the product or the legislation should come first, there was universal agreement among all the interviewees that the product comes first. Referring to the titanic disaster and the creation of SOLAS might be too much of a stretch. However, the worst-case scenario there might have to be an event of lives being lost due to MASS operations and insufficient SAR coverage before any change to the legislations are made.

5 CONCLUSION

By comparing the answers obtained through the interviews there were both unanimous agreement and deeply imbedded discrepancies. The main findings included challenges of both judicial and ethical concerns. There could be possible changes made to the traditional role of the master as well as new and defined sea areas now being a potential factor in SAR obligations.

All the participants who contributed to this bachelor thesis saw different actors pushing autonomy forwards. However, none of these actors was the people working at sea or even their major employers (the shipowners). In many ways, this brings the discussions back to the statements made at the very start, or in other words, the trail of discussion ends up being a circle.

Simply put, whenever new technology has been introduced to the maritime industry, there has been significant involvement from seafarers. However, MASS seems to be developed as a separate concept from the seafarer's umwelt. This creates a major challenge in which the possible interpretations, exemptions and/or developments made in the legislation and technology regarding SAR and MASS operations will be made without accounting for those who are the most directly affected by it. As mentioned earlier, the interviewees' personal perception of the driving forces behind autonomy does not necessarily address the actual challenges regarding MASS and the legislation. However, their difference in opinion and viewpoints could help display how far apart some of the actors involved in solving the future challenges are. Laws and legislation are meant to regulate behaviour in a way that reflects its subordinate's ethics and moral. Thus, this bachelor thesis wishes to underline the seafarers' lack of influence in the development of MASS and SAR regulations as the main challenge uncovered by the thesis. Furthermore, the last-mentioned challenge can also presumptively be applied to other aspects and challenges regarding the general development of MASS.

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7 APPENDICES

7.1 Appendix A: Interview guide

Introduction questions	**Follow-up**
1- What is your experience in the maritime industry?	Please do explain a little further what you are currently working with and for how long?
	What kind of education and/or work experience do you have that could affect your view on the topic?
2- Is your work directly or indirectly connected to autonomous ships?	
Reflective questions	
1- How well prepared is the maritime industry for autonomous ships in your opinion?	
2- What would you identify as the largest **judicial** challenges when it comes to SAR and autonomous ships?	- Does it challenge the legislation? - How? And in what way? - How do you interpret SOLAS chapter. V, Reg 33 which deals with the duty to assist in SAR situations at sea with regards to autonomous ships? - *The definition of «master»*
3- *Technical aspects aside;* what would you identify as the largest ethical challenges when it comes to SAR and autonomous ships?	- How will autonomous ships affect the maritime industries attitude towards securing lives at sea? - *Complying with "humane treatment within the capabilities of the ship"*
	- Is the distance between traditional shipping and autonomous ships large enough to justify exceptions from the legislation in regards of SAR? - Do you know of any other cases where there has been made exceptions in the legislation for new technology in the maritime industry?

	- In your opinion should the product or the legislation come first?
	- Could you describe your thoughts on how people with two very different work environments are expected to follow the same guidelines when it comes to SAR?
4- What about the risk aspect? (Technical aspects aside)	
5- What would you describe as your personal stance when it comes to autonomous ships and the legislation?	
Finishing off questions	
1- Is there anything you would like to add with regards to the topic?	
2- How did you experience the interview situation?	