The Shipmaster in Remote & Autonomous Operations

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Tämä tutkielma koskee laivanpäällikön vastuita etäoperoitavissa laivoissa. Tutkimus kohdistuu ensinnä kysymykseen siitä, voidaanko laivanpäällikön juridinen asema samaistaa etäohjauskeskuksen päällikön asemaan, toisaalta tutkielma käsittelee vaikutuksia oikeustieteen systeemissä jotka seuraavaat kun kyseinen samaistus tehdään.

Tutkimus kohdistuu pääasiassa merioikeuden kansainväliseen normistoon ja Suomen merilakiin. Tutkimuksen populaatio on merioikeuden alan toimijat, tutkimusyhteisö ja lainsäätäjät niin kansallisella kuin kansainvälisellä tasolla. Tutkimus rajautuu kansainväliseen velvoittavaan merilainsäädäntöön ja suomen kansalliseen merilakiin, joka suurilta osin vastaa pohjoismaista merioikeutta. Tutkielman tarkoitus on auttaa merialan toimijoita muodostamaan etäohjaustoimintansa juridisesti valistuneella tavalla, sekä antaa lainsäätäjälle suuntaviiva kysymyksille oleellisten juridisten elementtien käsittelyyn.

Tutkimusmetodi on oikeusdogmaattinen, jota on tuettu kvalitatiivisilla haastatteluilla. Tutkimuksen keskeiset tulokset olivat, että laivanpäällikön juridinen asema voidaan systematiikan näkökulmasta samaistaa etäohjauskeskuksen päällikön asemaan niin kansainvälisin kuin kansallisinkin kriteerein, ja että tällöin oleellisimmat ongelmat liittyvät fyysiseen aluksellaoloon ja hyvään merimiestapaan autonomisia järjestelmiä käytettäessä. Keskeisimmät toimenpidesuositukset ovat toisaalta Suomen merilain 6. luvun sanamuotojen muuttaminen mahdollistamaan etäohjauksen ja poistamaan epäloogisuudet systeemistä, toisaalta kansainvälisen merenkulkijoita koskevan sertifikaattijärjestelmän muokkaaminen paremmin huomioimaan etäoperoinnissa vaadittavat ja toisaalta siinä tarpeettomat taitovaatimukset. Keskeinen toimenpidesuositus alan toimijoille on riittävän valvonnan järjestäminen etäohjauskeskuksessa aluksen toimiessa autonomisesti, sekä tiivis yhteistyö julkisen vallan kanssa.

Asiasanat:
merioikeus – kansainvälinen merioikeus – laivanpäällikkö – päällikkö – autonominen – etäohjaus – navigointi – ANS – SCC – ROC.

Summary page

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This study examines shipmasters responsibilities in remote & autonomous operations. The focus of the study is first to answer the question whether the legal status of the shipmaster can be reasonably applied onto the chief operator of a shore control centre, and secondly to discuss the issues in international and Finnish regulation that come about when such application is made.

The research concerns itself with international maritime regulative instruments as well as the Finnish maritime code. The population of the study comprises of the private actors in the industry as well as the lawmakers on national as well as international level. The aim of the study is to support the private actors of the industry in forming their remote & autonomous operations in a juridically reasonable way, and to give guidance to the lawmakers to focus on the relevant elements when discussing remote & autonomous operations in maritime law.

The research method is legal dogmatic policy analysis that is supported by qualitative interviews. The results of the research are that the legal status of the shipmaster can be reasonably applied onto the chief operator of the shore control centre, generally domestically as well as with the requirements of international law, and that when this application is made, the relevant issues are around the vessel being unmanned as well as the fulfilment of the requirement of "good seamanship". The essential recommendations are to change the wording of the Finnish maritime code chapter 6 to better accommodate remote operations by removing the resulting incoherencies, and on the other hand to modifying the international system of certifications for seafarers to better accommodate the skills needed and not needed for remote operations. An essential recommendation for the private actors in the industry is to formulate their remote and autonomous system to include enough supervision during autonomous navigation to better ensure its acceptability, as well as close cooperation with the public authority in developing the field.

Keywords:
maritime – maritime law –shipmaster – remote – autonomous – ROC – SCC – shore control centre – responsibility – IMO – command – control – R&A – chief operator – unmanned vessel – periodically unmanned bridge – bridge 0 – b0

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I stand, no wiser than before" – Goethe, Faust.

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Abbreviations

AAWA	Advanced Autonomous Waterborne Applications
ANS	Autonomous Navigation System
B0	Bridge Zero
CMI	Comité Maritime International
COLREGs	The International Regulations for Preventing Collision at Sea 1972
CSO	Company Security Officer
D4Value	Design for Value
E0	Engine Zero
FMC	Finnish Maritime Code
FMM	Fleet Mission Management
ILO	International Labour Organization
IMCO	Inter-Governmental Maritime Consultative Organization
IMO	International Maritime Organization
ISM Code	International Safety Management Code
ISPS Code	International Ship and Port Facility Security Code
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78)
MASS	Maritime Autonomous Surface Ship
MLC	The Marine Labour Convention
MUNIN	Maritime Unmanned Navigation Through Intelligence in Networks
PFSO	Port Facility Safety Officer
R&A	Remote & Autonomous
RCS	Remote Control Station
ROC	Remote Operations Centre
SCC	Shore Control Centre
SOLAS	The International Convention for the Safety of Life at Sea, 1974
SSO	Ship Security Officer
STCW	International Convention on Standards of Training, Certification and Watch-keeping for Seafarers, 1978
STWGMLS	Tripartite Subgroup of the High-level Tripartite Working Group on Maritime Labour Standards
Tekes	Finnish Funding Agency for Technology and Innovation (now known as Business Finland)
UNCLOS	United Nations Convention on the Law of the Sea

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Ilir Fazliu, Rolls-Royce.

Markus Laurinen, Rolls-Royce.

1 Introduction

1.1 Introduction

Digitalization of different areas of life and commerce has been underway for years. The internet and other digital systems have revolutionized varying spheres of life, having been adapted to tasks and functions that were previously done manually. One could take as an example the idea of a simple factory. A factory used to function mostly by manual labour, be it the factory worker putting the product together at the assembly line, or the accountant in the administration working with paper and a pen crunching numbers. Work in such a factory changed dramatically through automatization through digital systems. The worker at the assembly line has been replaced by a robot, while the accountant works with multiple digital aids such as accounting and personnel management software.

Digitalization of systems has enabled expanded possibilities of automatization, and while the automatization of functions through the convergence of digitalization and robotics has reached futuristic proportions in some industries like aviation, others have yet to reach the same level of technological development. One of these is the area of commercial shipping. A specific level of automatization has of course reached the shipping industry, streamlining its functions and making it possible to decrease manning of the vessels while sustaining the practical capabilities of the crew. None the less, practically all ships on the seas are operated by people on board the ship where many tasks are still done manually with analog devices. This is not to say that there is no automatization on ships. A cargo ship has autopilots and systems for ease of navigation and for controlling different parts of the ship, but the process is still manual in many respects. Furthermore, there has been a wave of autonomation in the aviation and the automobile industries, with the marine industry following in tow.

Automatization of functions is the first step towards autonomation. These two terms can sometimes be seen used interchangeably, but understanding them properly is key to understanding what is really being discussed. Automatization is about developing a system that does the predefined work that used to be done manually by a person. This way the persons potential is liberated for tasks that the artificial system is incapable of doing. A simple example is a calculator, where instead of a person calculating the equation in his head, he inputs the equation into the machine that then does the calculating for him. Autonomation could be described as the next step from automatization. In an autonomous system the human is taken out of the decision making loop[1]. The artificial system is automatic in the sense that it can do the task on its own, and autonomous in the sense that it can decide what to do on its own as well. To return to our simple calculator example, an autonomous calculator would decide on its own what equation to calculate.

This wave of autonomation is beginning to sweep the industry, however. There have been demonstrations of commercial vessels being remote controlled as a logical first step before moving on to a vessel that operates autonomously on its own while still being able to be supervised. For example, the Norwegian company Kongsberg is developing an autonomous container ship called Yara Birkeland in cooperation with Yara, a Norwegian chemical company. The ship will be equipped with an automatic mooring system. The berthing and unberthing will be done without human intervention and will not require special implementations dock-side. The vessel is scheduled to start operations in 2019 as a manned vessel first and scheduled to be later switched to remote operations with the aim to start performing fully autonomous operations by 2022. A model of the vessel has been tested successfully proving both the concept and the technology.[2] Another example of a demonstration carried out is a vessel called "Svitzer Hermod", created in cooperation by Rolls-Royce and Svitzer, a global towage operator. In 2017 one of Svitzers tugs, the 28m long Svitzer Hermod safely conducted a number of remotely controlled manoeuvres. The vessel undocked from the harbour in Copenhagen, sailed for a short distance until making a full circle, sailed to the Svitzer headquarters close by and docked again. The operation was conducted completely with remote control.[3] In December 2016 the head of Rolls-Royce's Blue Ocean Team, Esa Jokioinen, made a statement saying "My thinking is that there will be more people working on autonomy in 2017 than there has been in the past. We are getting closer to

[1] Ringbom 2018, p. 5.
[2] Kongsberg, Final design of "Yara Birkeland" revealed – model commences testing at SINTEF Ocean, press release; Kongsberg, The world's first zero emission, autonomous container feeder; Rolls-Royce, Ilir Fazliu, 21.11.2018.
[3] Rolls-Royce, Rolls-Royce demonstrates world's first remotely operated commercial vessel.

demonstration and implementation, and we are likely to see more tangible results".[4] What seems certain is that Remote & Autonomous (R&A) operations are only going to increase in the future.

This has certainly come true, as a demonstration of the autonomous navigation system has taken place as well. In the end of 2018 Rolls-Royce and the Finnish state-owned ferry operator Finferries demonstrated the world's first fully autonomous ferry. The car ferry *Falco* used a combination of Rolls-Royce Ship Intelligence technologies to successfully navigate autonomously during its voyage between Parainen and Nauvo. The vessel detected objects utilizing sensor fusion and artificial intelligence and conducted collision avoidance. It also demonstrated automatic berthing without any human intervention from the crew. The president of Rolls-Royce Commercial Marine Mikael Mäkinen stated that the demonstration proves that the autonomous ship is not just a concept, but something that will transform shipping as we know it.[5]

Adapting new types of technology is by no means always easy, especially when the maritime industry is governed with a conservative body of legislation. The first laws governing shipping and maritime activity can be traced back to the Hammurabi code, dating back to circa 1780 B.C.[6] The classical, medieval and early modern era saw to the development of their own maritime laws with their basic elements having survived to the legislation of our times[7]. For example the current Finnish maritime code came into force in 1994, amending the previous code from 1939 that itself was based on older Scandinavian maritime legislation and tradition.[8] Legislation around an industry as old and stable as the shipping industry moves understandably with glacial speed.

Regulation can be seen as a tool for securing a variety of protectable interests, and while aiming for this goal it needs to cause the least amount of negative effects such as hindering development. Regulation can aim to address problems in the world caused by different actors and developments. This kind of regulative intervention was seen for example after the famous disaster of the Titanic, which showed the need for a unified set of rules governing the safety aspects of maritime ventures. The end result of this

[4] Esa Jokioinen, Ship Technology, Is 2017 the breakthrough year for unmanned vessels?.
[5] Rolls-Royce, Rolls-Royce and Finferries demonstrate world's first Fully Autonomous Ferry.
[6] Fordham University, Ancient History Sourcebook: Code of Hammurabi, c. 1780 BCE.
[7] World Encyclopedia of Law, Maritime Law History.
[8] HE 62/1994 vp, p. 1.

development was the Safety of Life at Sea convention of 1914 that. Regulation always follows the development of the industry, development which always creates new problems for regulation to address. When the principal elements of the industry have been there for millennia with regulation being built on it, a dramatic change in these principal elements causes issues in the regulative system.

Because the industry has only been the subject of limited automatization, its basic elements have always stayed there: ships are floating structures operated by people for mainly transporting people and cargo through water. To be able to operate the ship the operator always had to be on the ship, which has been the underlying principal element for all regulation in the industry. Automatization has however brought about the possibility of remote operations, where the ships systems have been automatized enough to allow it to be operated remotely without a crew aboard the ship to operate it. This has been made possible by on the one hand increasing the level of automatization to systems that haven't been automatized before, and on the one hand making away with the tasks required to sustain the crew on the vessel by taking said crew away from the vessel. Reaching the level where a ship has enough automatization to be operated remotely means that it is also close to having enough automatization to potentially operate itself autonomously. This development has caused the situation that currently a headache for many actors in the industry: the shift towards R&A systems challenges the basic underlying paradigm that the international and national regulatory frameworks governing the industry are built upon, namely that the crew is physically on the vessel. The marine regulation at its current state is not fit to properly handle R&A operations, and to be able to secure what it intends with the least amount of hindrance to the industry it has to find ways of accounting for the emerging disrupting effects of the development.

The motivations for making autonomous vessels a reality are varied. Moving the crew ashore the enables the vessels to be designed for carrying cargo without the need for systems to sustain human habitation. The systems for autonomous navigation are envisioned to make improve fuel consumption efficiency. Moving the crew ashore would end up in a more comfortable and safe working environment for the crew and decrease manning costs. Furthermore, having autonomous systems on a vessel would potentially increase the safety of marine ventures buy decreasing the potential for accidents while having less people aboard to be subject to the potential accidents. It has been recognized that most maritime accidents have been caused by human error. The current view seems to be that by using a computer to make the decisions on a vessel with the pure logic of its algorithms, accidents in marine sphere can be lessened dramatically[9]. The threat to the employment of seafarers that is caused by decreasing manning with autonomous systems is valid, but on the other hand managing and supervising the vessels is still a job for people, not to mention all the possible supporting and auxiliary services needed. The argument then is that while the companies would benefit from decreasing manning, the seafarer would not be the one bearing the cost as his employment would be secured by the other jobs that the solution creates.[10] One of the first near future applications is to retrofit conventional vessels to release the watchkeeping personnel from the bridge during low risk navigational situations, such as when the vessel is in open seas. This concept is called "bridge zero", the idea being similar to the currently in effect "engine zero" concept, where the engine room is attended only at times while otherwise being ran by automation.[11]

Autonomous vessels have already been the subject of a number of different projects for defining and mapping out the key issues and elements of the concept. One of these being the project MUNIN – Maritime Unmanned Navigation through Intelligence in Networks. The project was a collaborative research project, co-funded by the European Commission under its Seventh Framework Programme. The aims of the project were to verify a concept for autonomous ships. [12] The MUNIN project managed to define many of the key concepts in autonomous shipping and create a somewhat coherent and unified vocabulary for use in the field. Another and more recent project on the theme was the AAWA initiative, the name being an abbreviation of Advanced Autonomous Waterborne Applications. It was a project funded by Tekes (Finnish Funding Agency for Technology and Innovation) that aimed to produce the specification and preliminary designs for the next generation of advanced ship solutions. The project was conducted in collaboration with universities, ship designers, equipment manufacturers and classification

[9] Raconteur, Are autonomous ships the future?
[10] Anton Westerlund, 28.9.2018.
[11] Anton Westerlund, Anu Peippo, 7.1.2019.
[12] Project MUNIN (internet material).

societies, and it managed to explore many economic, social, legal, regulatory and technical factors for making autonomous ships a reality.[13]

Bringing autonomous vessels to the seas is not a very straightforward task. The amount of legislation governing the industry needs to be revised dramatically to accommodate autonomous vessels. It is well understood that the shift needs to be gradual, moving towards autonomy one small thing at a time. The way the shift is being envisioned is that first the vessels should be made applicable with national legislation through regulation that allows for experimental use. If enough certainty and experience gets accumulated, the next step would possibly be changing national legislation to accommodate for autonomous vessels in the territorial waters of the state. In this phase autonomous vessels could be used in coastal logistic operations of the state without touching the international sphere, possibly by creating specified testing areas where autonomous systems are used among conventional vessels. Legislative changes in the international level will take longer and will mostly be needed to be made through the International Maritime Organization (IMO), where the politics and agendas of all the countries in the world will doubtlessly hinder smooth progress in any question discussed[14]. The discussion in this thesis mostly concerns the Nordic countries, yet other questions emerge from the diversity in the global setting. The interests are different for the Philippines than they are for Finland.

In the next chapter I will present the basic key concepts of Remote & Autonomous operations.

1.2 Defining key concepts

Autonomous vessels have yet to be defined in legislation.[15] In layman's vernacular an autonomous vessel can be described as a ship that is capable of making decisions without human intervention. Autonomous vessels are usually associated with being unmanned, yet this is not necessarily the case[16]. Autonomous vessels are in some cases called *MASS* for *Maritime Autonomous Surface Ships*[17]. The definition offered by MUNIN is one created by the Waterborne Technology Platform, which is the European Research

[13] AAWA whitepaper, p. 5.
[14] Aleksi Uttula, 15.10.2018.
[15] Erik Tvedt, Ship-Technology, Is it time to talk about regulating autonomous ships?
[16] Anton Westerlund, 1.4.2019.
[17] Norwegian Forum for Autonomous Ships, Definitions for Autonomous Merchant Ships, 2017.

and Innovation Platform for Waterborne Industries. An *autonomous vessel* is then described as a vessel:

> *"(…) which is equipped with modular control systems and communication technology to enable wireless monitoring and control, including advanced decision support systems and the capabilities for remote and autonomous operation."*[18]

An autonomous vessel is fitted with a computer to process the data gathered from the various sensors on the vessel, and make a navigational decision accordingly. One could say that the computer is the brain of the vessel, while the sensors work as its eyes and ears.

The computer system that navigates the autonomous vessel is called the *Autonomous Navigation System* (ANS). MUNIN has defined the ANS as a system:

> *"(…) which follows a predefined voyage plan within certain degrees of freedom to adjust the route in accordance with legislation and good seamanship autonomously e.g., due to arising encounter situations or significant changes in weather".* [19]

An autonomous vessel will not be totally independent however, since whenever there is a situation where human intervention is needed, for example when the vessels computer does not identify an object on its sensors, a human can step in and take direct control of the ship remotely from ashore. This is to say that an autonomous vessel, while having no crew aboard the ship, does have something resembling a crew ashore. The centre from which the crew operates the vessel is called a *Shore Control Centre* (SCC) by MUNIN, and is defined as a centre:

> *"which continuously monitors and controls the autonomously operated vessel after it is being released by the on-board crew of skilled nautical officers and engineers."*[20]

From the SCC the crew is able to both remotely monitor a vessel without interfering in its decision making and take control of it when necessary. The model created by MUNIN comprises of amongst others the positions of:

- *A Shore Control Centre Operator*, who monitors the safe operations of several autonomous ships simultaneously from a cubicle station and controls the vessels by giving high level commands, e.g., updating the voyage plan or the operational envelope of the autonomous system[21];

[18] MUNIN's final brochure, p. 1. (accessible at www.unmanned-ships.org/munin/).
[19] *Ibid.*, p. 2.
[20] *Ibid.*
[21] *Ibid.*

- *A Shore Control Centre Engineer*, who assists the operator in case of technical questions and who is in charge of the maintenance plan for the vessels based on a condition-based maintenance system ensuring sufficient reliability of the technical system for the next voyages[22];

- *A Shore Control Centre Situation Room Team*, that can take over direct remote control of a vessel in certain situations via a shore side replica of the unmanned vessel's bridge including a *Remote Manoeuvring Support System* that ensures an appropriate situation awareness in direct control despite of the physical distance of the crew and vessel[23].

The model for the SCC that is used in this research is the one envisioned by Rolls-Royce. The model is used as the basis for this thesis because it is a practical and defined one, which makes it useful for analysing. This model is called the *Remote Operations Centre* (ROC), a term that has already become commonly used in petroleum, defence and aerospace industries, among others.[24] The model is quite similar to the MUNIN one, but they are different in that they use different terms and division of tasks. Furthermore the model by Rolls-Royce is more specific and clearly aimed for a practical solution, while the MUNIN model seems to have been made to give a general idea of a SCC. The idea of what a ROC is, is basically the same as how the SCC is defined by MUNIN, and these terms can very well be used interchangeably. Terms made by Rolls-Royce are used when explicitly talking about the Rolls-Royce concept, and MUNIN terms are used when discussing about R&A operations in general. The ROC system designed by Rolls-Royce is presented in detail in a later chapter.

1.3 Scope of the research and methods used

A conventional ship has a crew physically on board. This crew consists of a set of seafarers well understood and defined in regulation. The pinnacle of these crewmembers is the shipmaster, who has a multitudes of rights and duties laid upon him by international and national regulation alike, as well as by private contract. These rights and duties have evolved throughout the times to reflect the special role and circumstances that befall him. But who is the shipmaster when the vessel becomes unmanned? Can the legal status of the shipmaster be assigned to a person ashore? What does it mean for the regulatory system if this type of assimilation is done? This research aims to look into the idea that the legal status of a shipmaster will get assigned to the person remotely in command of the vessel on the SCC, through the scope of international law and briefly

[22] *Ibid.*
[23] *Ibid.*
[24] Farrelly 2007.

through the frame of the Finnish Maritime Code. The research is done to identify what the status of a conventional shipmaster consists of and whether it is systematically possible or reasonable to apply his legal status to the SCC chief operator. Furthermore, the task is to analyse the legal status of the shipmaster when it is indeed applied to the SCC chief operator. What is aspired to is a clearer understanding of the regulatory situation regarding the SCC chief operator in international legislation and Finnish national legislation when moving to R&A operations. While doing this the composition of the SCC is discussed with its roles and structure, and comments are made on the R&A systems as they are envisioned currently. This will hopefully aid legislators and developers in the industry to better focus their attention to the relevant legal details as the field develops.

The research mainly concerns unmanned autonomous vessels while also analysing and making comments to vessels with a bridge that is periodically unmanned. The focus is on commercial dry cargo vessels instead of tankers, passenger ships, warships or others of the sort, while the results can very well be applied to these different ship types as well. The main legal sources of the research are the conventions administered by the International Maritime Organization (IMO) and the International Labour Organization (ILO) on the level of international law, and the current Finnish maritime code for the level of national regulation. As the basis for the SCC system I have taken the Remote Operating Centre -concept proposed by Rolls-Royce Marine. In the text the words “ship” and “vessel” are used interchangeably. To avoid awkwardness of expression the masculine English pronoun “he” is used throughout the text when referring to a person, and her while referring to a vessel. No bias is meant thereby and none should be construed.

Balancing risk and reward is a fundamental part of the liability system. When an action is relatively low-risk and greatly serves the interests of the society, the mode of liability is usually “normal” liability. The other side of the coin is that when an action is relatively high-risk and only serves the interests of the few, the mode of liability is (or should be) stricter. In the case of relatively high-risk actions that greatly serve the interests of the society, there can be instruments such as monetary funds, insurance schemes or division of tasks between the private and public actors. This is to say that when thinking of what the mode of liability is for an action, such as the one that the SCC chief operator faces, one has to take into account the positive and negative aspects of the modes as well as the tasks themselves. Strict liability mode serves better the rights of the end-user than the manufacturer, while the normal liability mode better serves the interests of the actor. The discussion about liability systems is not in the core of this thesis, yet I feel it is important to pay some mind to it in this context.

The method of the research is to first figure out what a conventional shipmaster is, what R&A operations are and how their systems and role compositions are designed and envisioned. In doing this some aspects of the R&A concept deemed important are discussed as well, such as the question of the requirement of good seamanship in Autonomous Navigation System. From there the thesis moves on to Applying the legal status of the conventional shipmaster on to the SCC chief operator by looking at the relevant legislative instruments in international law and the Finnish maritime code. This is done by analysing the relevant rules in the instruments in light of the new situation to see whether the application creates regulatory problems or inconsistencies, what these regulatory problems and inconsistencies are and what they mean for the regulative system. In the end a comment will be made for what the legal status of the SCC chief operator will end up being if the status of a shipmaster is applied on it.

To understand the industry, the technology and legislation in practice I have employed the method of qualitative interviews on Rolls-Royce employees, university professors and members of the Finnish Transport and Communications Agency (Traficom). The group of interviewees consists of professionals from different sides of the table in the field, such as engineers, programmers and master mariners, among others. The paper has gone through review by Rolls-Royce Marine to make sure that no information under a non-disclosure agreement is leaked in publication of this thesis, and the informed consent of the interviewees has been obtained from everyone interviewed. The interviews were conducted in a semi-structured way by asking the interviewee to tell about a specific concept and asking further relevant questions as they emerged. No personal information was written into or given out in this thesis.

The research has been done for and funded by Rolls-Royce Marine. From Monday 1st of March 2019 Rolls-Royce Marine became Kongsberg Maritime. The majority of the thesis was written before the acquisition, thus in this thesis the company is still referred to as Rolls-Royce Marine, as it was during the writing process. Rolls-Royce Marine should then be read here as currently Kongsberg Maritime.

The pure scientific aims of the research are:

1) to provide a comprehensive analysis on the legal status of the SCC chief operator in R&A operations using the Rolls-Royce ROC model;

2) to analyse the ROC concept, its possible orientations and legal implications, and;

3) to highlight the regulatory problems of R&A operations in international regulatory instruments as well as the Finnish Maritime Code.

The hypothesis found in this research relating to control and command is that direct control of an object can be fulfilled by supervision and being able to instantly take control of the control-subject. This is to say that to be in direct-control of something doesn't necessarily mean that the person operates it by his own hand, rather that it is so even when the person is only directly supervising the subject. This concept is further discussed in the chapter dealing with direct control and command.

The proverbial "beef" of the R&A issue seems to be twofold. On the one side the difficulties start to emerge when the last person leaves the boat, that is when the vessel is totally unmanned. On the other the difficulties start emerging when the autonomous navigation system starts making navigational decisions without supervision. The key words are *unmanned* and *autonomous*, both of which result in regulatory problems further discussed later in this thesis.

The aims of Rolls-Royce are similar in the sense that they stand to gain from research that helps them orient their ROC concept properly to confront the legal questions in this development. While conducting the research I have strived to keep my objectivity by using varied sources whenever possible and keeping a distance to the company funding the research. To my academic pleasure my supervisor at Rolls-Royce Marine has proven to be respectful of my academic liberty and interest of objectivity from the beginning, and I feel that I have not been given any information to indicate what the company would want my results to end up being. This has helped me with being objective by not giving me a proper idea of what the company would even want the end result to be, thus I feel it has had no real impact on my objectivity. However, no pure objectivity exist because everyone has their own frame of reference and intentions, and I am conscious of the fact that I may be less objective in things I do not consciously perceive. I tend to think of things from the point of view of "how can we make this work?", and by getting most of my information from the company I might have unconsciously framed the questions in a way that advocates for the results that the company wants to achieve. The way to objectivity however lies in transparency, thus I guide the reader to keep in mind the possible bias in this research. This thesis is optimistic about the possibilities of technology in achieving greater efficiency in functions, yet acknowledging the fact that there are always winners and losers in every significant technological paradigm shift, and that technology cannot always solve all difficult questions.

1.4 The sources of international law affecting the shipmaster

This chapter is about the legal sources of the law affecting the shipmaster. While maritime law is in a sense national law, the national and international regulatory elements in it are entangled. Furthermore the rules affecting the shipmaster are various and found in different levels of regulation and formulated in a multitude of conventions and case law. A short summary of the relevant sources is presented here.

The legal sources governing the shipmaster can be presented in the following way. International conventions create the guidelines, standards and objectives that need to be adhered to and implemented with national legislation. National legislation, then, provides the main substantial body of the regulations pertaining to the Shipmaster. The legal status of the shipmaster is further refined by the charterer's instructions to the master, through contractual principles. The Master is given a wide scope and great authority in flag state law because of ”the special circumstances and conditions in which ships operate – namely the danger of the sea and the distance from the port”.[25] Flag state law means, simply put, the national law of the state that the vessel is registered to, which is the law that is applicable aboard the vessel.

National law, international law and European Union regulation function in different capacities. National law works on the national level inside the state and is crafted by the state for it to use domestically. In a dualistic system such as Finland, international conventions need to be implemented as national law. International law then affects national law by the merit of being accepted and implemented by the state, and could be seen somewhat primary in relation to national law, as a states options for amending international law applicable to it are limited to agreeing or disagreeing to apply a

[25] Cartner – Fiske – Leiter 2009, p. 88.

convention. The law of the European Union has instruments that are either directly applicable in its member states as is, need to be implemented by national law to achieve the defined results, or ones that are merely recommendations with no negative legal repercussions for non-compliance.

The principal international body dealing with laws and matters of a shipmaster is the International Maritime Organization (IMO), an organization under the United Nations. The IMO was first established as the Inter-Governmental Maritime Consultative Organization (IMCO) in 1948, becoming an entity of full force and effect in 1958. The IMO aims to promote intergovernmental cooperation within the shipping industry, improve maritime safety and prevent marine pollution. It is a quasi-legislative body for regulating shipping and other matter of the ocean. Many of the laws affecting the shipmaster originated or are reflected in conventions that were created by or are administered by the IMO. The IMO administers UNCLOS 1982, and the result of its work tends to concentrate on prevention of accidents through three key agreements: SOLAS[26], MARPOL[27] and STCW[28]. The ISM[29] and ISPS[30] codes are also important in this regard.[31]

The International Labour Organization ILO was founded in 1919 to promote social justice.[32] Its objectives are to promote the regulation of work hours and labour supply, the prevention of unemployment, the provision of adequate wages, the protection of labour against health effects from employment, the protection of children and women, the economic provision for old age and injury, the protection of foreign workers, the promotion of the principle of equal remuneration for work of equal value, the recognition of the principle of freedom of association, the organization of vocational and technical education and other measures.[33] The importance of ILO regarding this research is in its promulgation of conventions dealing with maritime labour which comprise international law affecting the shipmaster when contracted by states.[34] The Marine Labour

[26] International Convention for the Safety of Life at Sea, 1974.
[27] International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78).
[28] Internation Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.
[29] International Safety Management Code.
[30] International Ship and Port Facility Security Code.
[31] Cartner – Fiske – Leiter 2009, p. 41–42.
[32] Constitution of the International Labour Organization, 28 June 1919, pmbl., 15 UNTS 35.
[33] Cartner – Fiske – Leiter 2009, p. 45; ILO History, *See generally* ILO homepage (www.ilo.org).
[34] Cartner – Fiske – Leiter 2009, p. 46.

Convention (MLC) has been designed to complement the key IMO conventions (SOLAS, MARPOL and STCW) as the "fourth pillar" of international regulatory regime for quality shipping.[35]

This research focuses mainly on international law affecting the shipmaster. It is however not lost on the author that national law creates the practical bulk of the maritime regulatory system. For this reason the Finnish maritime code has been taken as the source of national legislation affecting the shipmaster.

In the next chapter I present the ROC system designed by Rolls-Royce with its division of tasks and envisioned roles, from where I will move on to discussing the view of seeing the Shore Control Centre as an analogy for the navigational bridge. I Will then discuss the Autonomous Navigation System (ANS) and the requirement of good seamanship in navigation to argue whether or not the ANS could be used to substitute the human watchkeeper on a vessel.

2 Remote Operations Centre

2.1 General overview – Structure, role and functions

The *Remote Operations Centre* is the centre from which Remote & Autonomous operations are conducted. It somewhat resembles a navigational bridge by its visual and practical design, and in envisioned operation all that can be done from a navigational bridge can be done from the ROC. By the virtue of remote control and digital infrastructure the ROC can be situated virtually anywhere, be that by the coast or further inland. Connectivity, while in the early days being limited by the radio ranges, currently through satellites enables the remote operation of vessels potentially anywhere in the world. In practice the ROC is made up of a series of monitors and controlling apparatuses and thus will not need a peculiar amount of space, which makes it foreseeable that the ROCs will end up being located in the office buildings of the companies operating them. The only practical constraint for the location of the ROC is a reliable and efficient digital infrastructure enabling sufficient communications with the vessels.[36]

The way the hierarchy is structured on a conventional vessel undoubtedly serves as a good starting point for figuring out the most acceptable and pragmatic way of organizing

[35] Lielbarde 2017, p. 1.
[36] Anton Westerlund, 28.10.2018.

the ROC. Thus, the ROC is planned to have a structured chain of command resembling the one found on conventional vessels. Whereas a ship would comprise of a shipmaster on top of the command chain with the crew serving under him, ROC would have a "ROC crew" comprising of a "ROC Captain" and the various operators working under him.

The roles in ROC comprise of three different positions. The ROC captain works as the commander of the crew at the management level, and as his subordinates at the operational level are two types of operators: *Fleet Mission Management* (FMM) operators and *Remote Control Station* (RCS) operators, with different tasks accredited to them. The task of the FMM operator is to work on a "strategic" level on tasks such as planning the mission, setting the waypoints on the voyage plan and managing the needed resources for different sea-legs, such as the RCS operators on duty. The RCS operator works on a more "tactical" level, being the direct supervisor and controller of a vessel. The ROC Captain is the one ultimately responsible for his team and of the vessel and is envisioned to be something resembling a conventional shipmaster. These roles and their tasks are presented in the table below.[37]

ROC Captain	FMM Operator	RCS Operator
• Approving mission plans, the single routes within and related resource management • Responsible as the team leader for the operators and the maintenance staff in ROC	• Creates missions including scheduling of resources. • Mission monitoring • Responding to alerts and alarms coming from vessels under autonomous control	• Manning of the RCS as a direct controller • Monitoring the vessel when in supervised navigation • Controlling the vessel directly when in remote control

[38]

Where a single shipmaster is responsible for one ship, a single ROC captain will be able to oversee and operate multiple vessels. The vessels are not tied to a single ROC and a single ROC is not tied to a single vessel. The crew on a conventional ship is also fairly

[37] Anton Westerlund, 7.1.2019.
[38] *Ibid*.

fixed while the personnel working in a ROC can change at any time by changing work-shifts.

The structure of the ROC imitates the one on a conventional vessel. The command chain is structured so that there is one person with the rights and responsibilities on top as the leader while under him are the personnel that carry out his commands. The ROC captain is envisioned to be analogous to a conventional shipmaster and to who the related duties and responsibilities would be transferred to. However, the situation on board the vessel is very different from what it is ashore. There might not be an actual practical reason to have the team leader as the one from who the duties and responsibilities flow to the crew. One possibility in theory would be to allocate the applicable responsibilities of a shipmaster to a single RCS- or FMM operator, or perhaps divide the rights and responsibilities to different roles.

In this thesis the term responsibility is understood as the tasks and functions that an actor is expected to perform, such as the task of the shipmaster to represent the shipowner as an agent. Another closely related term is “liability”, which is to be understood here in the sense that the actor who is liable for something is the one who will face the negative repercussions of an event. The shipmaster who is liable for something would then be the person who ultimately has to pay damages of the accident or face the criminal penalties of his actions. However, the shipmaster is responsible for things that the shipmaster might be liable for, which makes the distinction important.

In theory there might be nothing to prevent the rights and responsibilities to be collective in the crew. The reason that the structure is basically copied from the conventional model seems to be that it makes the idea of the ROC more acceptable and easier to market, while also making it easier to adopt into the current regulative system[39]. Another possible reason is that because the idea is so novel there hasn’t been time or experience to innovate on the structure to make it as efficient as it can be. Instead of having to craft a new system we can take as the basis a system that already exists and apply that into the new structure. While I feel I understand the possibility of a more creative structure, it cannot be denied that at this point of the development the idea of a structure resembling the conventional one is the most valid and generally most acceptable.

[39] Anton Westerlund, 28.10.2018.

Structure aside, the question whether the responsibilities should be allocated to someone else than the SCC chief operator, or somehow divided between the operators and the SCC chief operator needs to be addressed, at least preliminarily. The rationale is somewhat similar as on a conventional ship. On a conventional ship there is one master who in the end holds all the responsibility with his underlings acting merely as the extensions of his will. It would be very impractical to require a single navigator to have the same certifications as a master does, and the same rationale applies in the SCC. It is much more practical to have one person in charge with the relevant expertise, certifications, rights and duties, with his underlings working as his extensions, each one executing a part of the commanders' tasks allocated to them. In this sense it would seem as the most practical solution to focus on crafting a system where the SCC chief operator is the nexus of powers and responsibilities of the ships navigational crew. This would not however prevent a normal operator from working as the chief operator if he is certified for it, because just as in a conventional vessel the navigator can also be the master. It would thus not be a requirement to have two different people in the SCC. A composition of only one person in the SCC could technically be possible, just as with smaller conventional vessels of our day are allowed to have only one person working technically as the master on a managerial level, as well as the direct operator on an operational level.

In this chapter I have gone over the preliminary setup and composition of the Rolls-Royces proposed ROC concept, the different roles in it with the tasks allocated to them, and have addressed the act of copying the command structure from a conventional vessel to the new system. I have also made a comment on the idea of how the tasks of a shipmaster should or should not be allocated and divided to the operator roles on the SCC. In the next chapter I will argue for using analogy for understanding the concepts of "navigational bridge" and "SCC".

2.2 SCC and the navigational bridge – an analogy

If the ship is a body, the bridge would be its brain. All the functions done on the vessel can be traced back to the bridge, or more specifically to the master that gives out the orders for the operation of the vessel. If all the functions that are conducted on the vessel can be carried out as efficiently from ashore as from offshore, moving the personnel from a vessel to the SCC would only constitute a spatial displacement of the "brain". In principle it shouldn't matter where the functions of the vessel are conducted from, as long as they can be carried at least as reliably and efficiently as in the conventional setting. I argue that the SCC can be treated as an analogy for the navigational bridge because in their elements they are virtually the same, if only different in technical and spatial respects.

The navigational bridge on a vessel has a set of elements. It is the place from which the functions of and tasks on the vessel are conducted. All communication from different parts of the vessel inevitably lead back to the bridge and to the shipmaster, who is in an abstract sense the information/authority nexus for everything that happens on the vessel. Another important aspect of the navigational bridge is that it is the place from which watchkeeping is essentially carried out. The bridge houses the watchkeeping personnel and the devices used to monitor the vessel and its surroundings, in addition to the possible radio station that is usually situated in the vicinity of the bridge for immediate access to the shipmaster and the crewmembers in charge of navigation.

The SCC itself comprises of monitors and other digital systems used for controlling and monitoring the vessels functions and surroundings. The SCC is connected to the intelligent situational awareness system and the ANS of the vessel to make it possible to carry out watchkeeping duties, and the personnel in control of the vessel are situated there because all the vessels functions can be accessed from its terminals. Virtually all the information obtainable from being on the bridge of a vessel can be also obtained in the SCC. However, two issues have been noted regarding the availability of the information. Getting proper auditory information through the sensors seems not to have been the main focus in the development of the autonomous ship sensors, but traditional vessels have enclosed bridges in most of the cases anyway, an aspect that has hampered with the availability of auditory information and that has been factored in to international law[40]. Auditory information is important however, because the navigator relies on the sound of the engine when piloting the vessel to better get his bearing.[41] Sensors for proper audio are currently being developed and integrated to the system, which can potentially make the audio information gained even better than that which could be

[40] *See* ISO 14859:2012 which deals with standardization of sound reception systems for totally enclosed bridges.

[41] Kevin Daffey, Lord Kelvin Lecture, Rolls-Royce's vision of autonomous shipping, Institute of Marine Engineering, Science & Technology, 12.12.2017.

obtained from the bridge.[42] The other issue seems to be the ability of the operator to get a proper bodily feel of the vessel because he is not on the vessel physically.[43] This, however, does not yet seem like a fundamental problem at this stage of the development. Furthermore, it is possible that the potentially added benefits of the other sensory systems outweigh this lack of haptic feedback.

Comparing the SCC and the navigational bridge of a vessel must be made on a case-by-case basis. On a traditional ship the information obtainable on the bridge is consistent by the virtue of just having a person with proper sight and hearing on the bridge, whereas in the SCC the obtainable information depends on the technical capabilities built into the system and the sensors fitted on the vessel. The analogy can only be made if all the relevant functions that can be efficiently conducted from the navigational bridge and all the necessary information that can be obtained from on board the vessel can also be as efficiently and reliably obtained from the SCC. For example, if the vessel does not have the sensors to obtain visual data, no analogue can be made since the SCC would have no visual information that would otherwise be available if there was a person on board and attending the bridge. Thus, the test for the analogy is whether the obtainable information and the possible executable relevant functions from the SCC are at least as varied and effective as if the crew operating the vessel was aboard. Finding the elements from which the standards of exactly how effective and varied the functions and information need to be for the analogy to be made is essential for future assessing of the acceptability of both a vessels' autonomous system and the SCC operating it.

From finding a model for the SCC that can be accepted as an analogy for the navigational bridge we can move on to creating a standard for the SCC as well as the autonomous vessel. Currently the authority for controlling vessels safe manning is with the national governments[44]. After verifying the safe manning level for each individual ship they issue a safe manning certificate that verifies that the manning on the vessel is acceptable and cannot be deviated downwards from. The same system could in my opinion be used to certify the autonomous vessel and the SCC. The role composition of a single SCC will likely be static, and the ships fitted with R&A systems will likely be operated in a uniform

[42] Anton Westerlund, 28.10.2018.
[43] Wahlström – Forster – Karvonen – Puustinen – Saariluoma 2019, p. 192.
[44] SOLAS reg 14.

way. The lack of variety makes it even easier to create proper standards. This way they the national government could verify the acceptability of the technological and operational solutions used in the SCCs and the vessels they control, according to a pre-formulated standard.

Safe manning when applied to the SCC would concern the amount of operating personnel and equipment per vessel. If the SCC has consoles for only controlling a very limited amount of ships remotely at the same time, it would harder to accept a very big amount of ships under its control. The number of operators, the amount of operating equipment and the number of ships in command at the same time are then to be balanced. Characteristics of the operated vessel would also be needed to be considered, because the operators would need to have knowledge of how one type of ship operates. This aspect is more essential in the near future with retrofitted vessels, but in the long term the new autonomous vessels will possibly be much more uniform in style than current ships, which then decreases the need for a single operator to have the knowledge of a more diverse set of ships.

When it comes to certifying an autonomous vessel, there has already been research into the idea of applying the “goal-based” approach of the IMO Polar Code into creating an “Unmanned Ship Code”. As the Polar Code is fundamentally performance-based in the sense that it determines goals that have to be reached instead of enforcing a specific solution, the idea seems to be highly applicable to regulating autonomous vessels as well. The requirements would define the goals for ship functions that those autonomous vessels would then have to meet. The ship would then be certified for unmanned use if it meets these goals.[45] Something similar could very well be imagined for a certification system of the SCC’s, likely a system that takes care of the certification of both the vessels and the SCC solutions.

In this section I have argued that the Shore Control Centre can reasonably be seen as an analogy for the navigational bridge if its technical capabilities allow for executing the same tasks as effectively as those that are executable from a conventional bridge, and if at least the same amount and quality of relevant information is obtainable on it as would be obtainable from a conventional bridge. In the next section I will present the

[45] Bergström – Hirdaris – Valdez Banda – Kujala – Sormunen – Lappalainen 2019, p. 881-883.

Autonomous Navigation System and discuss the requirement of good seamanship related to it.

2.3 Autonomous Navigation System and the requirement of good seamanship

The rules that require good seamanship, as well as any other set of rules for that matter, have an underlying aim instead of being there just for the sake of it. Something is meant to be achieved with the rules, and the rules should be understood through the scope of their objective, as instruments to fulfil these goals. UNCLOS for example states security as one of its aims[46], and the rules in maritime law should then be understood as tools for achieving this end, among others. This is to highlight that the rules discussed in this thesis need to be seen through the view of the aims that they are meant to fulfil. For the requirement of good seamanship these aims are to promote safety and security by making sure that the person (or object) in charge of navigation has the proper skillset to conduct the functions in a manner that is safe and secure.

The crew on a traditional vessel has to operate the vessel according to good seamanship.[47] Good seamanship is a standard of conduct that a good seaman would consider proper in operating the vessel, formulated by his knowledge and professional experience. How a good seaman operates the vessel still boils down to technical rules applicable to different situations. How to navigate the vessel in a specific circumstance? How much and which direction should the vessel deviate from course to avoid collision? What is the correct conduct to ensure the safety of the vessel? In a sense good seamanship comes close to programmed behaviour, technical rules that can be programmed into the computer system operating an autonomous vessel. This idea seems to have been adopted by the MUNIN initiative as well. In their final report an *Autonomous Navigation System* (ANS) is defined as following a predefined voyage plan with certain degrees of freedom to adjust the route in accordance with legislation and good seamanship autonomously[48].

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[46] UNCLOS preamble: "*Believing* that the codification and progressive development of the law of the sea achieved in this Convention will contribute to the strengthening of peace, security, cooperation and friendly relations among all nations in conformity with the principles of justice and equal rights and will promote the economic and social advancement of all peoples of the world, in accordance with the Purposes and Principles of the United Nations as set forth in the Charter".

[47] COLREGs, Rule 2 (a).

[48] MUNIN's final brochure, p. 2.

The core of good seamanship reveals itself when things go unexpectedly. The value of good seamanship is in a traditional situation where the navigator comes up to an event with no clear rules and has to get creative with operating the vessel in the safest of ways and applying his experience and knowledge to avoid disaster. The issue is constituted in Rule 2 (b) of COLREGS, which states that:

> "In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger."[49]

The rule above does not only give a permission to depart from the navigational rules if following them would result in immediate danger, but makes it a duty to do so.[50] This is clearly a necessary issue to discuss when it comes to autonomous systems, because autonomous navigation is programmed behaviour that cannot be creative when a situation arises that doesn't conform to the programming. The issue is being addressed with the use of the Shore Control Centre. When the autonomous vessel cannot execute its programming in an unexpected situation, the system alerts the remote-controller to take control of the situation. This way the rule requiring good seamanship can in a certain sense be adhered to. When good seamanship needs to be applied, there would be a person in control who makes the decision.

A seafarer navigating the vessel uses his eyes and ears to get a sense of the vessels' surroundings, albeit with the aid of technical instruments. This requirement is stated in COLREGs Rule 5:

> "Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision."[51]

An autonomous vessel uses the different sensors installed on it as its senses, and to be able to make sense of the sensory feeds it needs to combine them in a process called "sensor fusion". Through sensor fusion the computer combines for example visual and radar information in lieu with sea charts and global positioning system information. In a conventional vessel the operator makes this sensor fusion in his own head, yet the idea

[49] *Ibid.* (b).
[50] Cockcroft – Lameijer 2016, p. 4–5.
[51] COLREGs Rule 5.

is virtually identical.[52] Having the computer do the same that the human would do and sense what the human would sense makes virtually no difference, except the computer is potentially able to sense and identify things faster with more efficiency and reliability, eliminating the human error. This is not to say that there is no difference, as a human is capable of making moral choices, rather what is emphasised here is that a human turning the wheel and a machine turning the wheel effectively causes the same end-result. Furthermore, the term "proper look-out" has always been interpreted by the courts as including the effective use of available instruments and equipment, in addition to the use of both sight and hearing[53], which makes it almost sound like the use of autonomous navigation systems has to be used if installed, if the technology is found to be successful in practice.

However, a study in the D4Value research programme funded by TEKES exploring how ships (i.e., their crew or the shiphandler present on bridge) considers other ships in ensuring safe passage, published in 2019, stated that:

> "Sea traffic could be seen as a social system in consisting of actors that consider and anticipate each other for the purpose of navigational decision-making. In human behaviour, this relies on innate social capabilities, but the present-day AI solutions do not enable human-like perspective-taking. That is, viewing a situation from the point-of-view of another person"[54]

This would indicate that while the ANS seems to be highly sophisticated and reliable for navigational tasks, it would be hard to argue that the ANS could totally substitute the human in navigational tasks. Rather a better argument would be to look at the ANS as the next step from the autopilot, a system able to make navigational decisions but still in need of supervision from a human operator, albeit to a much lesser extent. Getting rid of the human however seems to be implausible at this point of the development. However, the language used in IMO publications seems to suggest that the "human-in-the-loop" may not be all that important[55].

[52] Anton Westerlund, 28.10.2018.
[53] Cockcroft – Lameijer 2016, p. 13.
[54] Wahlström – Forster – Karvonen – Puustinen – Saariluoma 2019, p. 192.
[55] American Nautical Services, IMO Prepares for Necessary Autonomous Ship Regulation Amendments 1.2.2019: *"Degree one: Ship with automated processes and decision support. In this case, although the ship features technological advance in equipment, seafarers remain on board to monitor, operate and control shipboard systems and functions. Certain operations may be automated and occasionally unsupervised. However, seafarers on board are prepared to take over when necessary".*

In this section I have presented the Autonomous Navigation System and discussed the requirement of good seamanship in navigational tasks. I have argued that while the system can certainly be seen able to substitute the human for watchkeeping duties when it comes to the requirements in regulation, it seems that the system cannot really be used to get the human out of the loop completely. The system should be supervised in some way to fill the gaps in the aspects of navigation that the use of the ANS creates by substituting a human.

2.4 Conclusions

In this chapter I have presented the Remote Operations Centre concept designed by Rolls-Royce with its envisioned roles and division of tasks. I have made an argument for seeing the Remote Operations Centre as an analogy for the navigational bridge of a conventional vessel, but only if the functions that can be executed from it are at least as varied and effective as those executed from the bridge of a conventional vessel, and if the relevant information that can be obtained on the Remote Operations Centre is qualitatively and quantitively as good as from a bridge of a conventional vessel. I have further discussed the Autonomous Navigation System employed in autonomous vessels and the requirement of good seamanship in navigation related to it. From this I have concluded that the ANS can be seen as a worthwhile next step from the autopilot in automating navigational tasks, but that it might not yet be employed to totally substitute the human in the loop, as the system is incapable of creative behaviour and perspective taking that is needed to be able to go against the "rules of the road" when the situation so demands. However, with these conclusions in mind, it would seem that as the issue of not being physically on the vessel is not an unsolvable regulatory barrier, the next step is to look at the shipmaster himself and see whether his legal status could be applied to the SCC chief operator.

3 Shipmaster and the ROC captain

3.1 What makes a shipmaster

To put the role of the ROC captain in context we first need to figure out what it actually is in the legal sense. The logical starting point is to try to see if it can somehow fit the role of the shipmaster on a conventional vessel. From the first look it would seem that the ROC captain is closer to the role of the shipmaster than anything else, albeit moved from the vessel ashore. But to properly analyse this we first need to figure out what exactly are the ROC captain and the Shipmaster in the first place. The key question is whether their differences can be bridged for some kind of an analogy to make sense. In this chapter I analyse the definitions of a shipmaster to make sense of how it the role is defined, and to better understand what really makes a shipmaster.

The shipmaster, also called "master mariner" and for which the legal term is usually "master" in maritime law, has many varied definitions.[56] Black's law dictionary defines Master as:

> "Master of a ship. In maritime law, the commander of a merchant vessel, who has the chief charge of her government and navigation and the command of the crew, as well as the general care and control of the vessel and cargo, as the representative and the confidential agent of the owner.[57]

Cartner, Fiske and Leiter define the Master as follows:

> "a natural person hired by contract who lives on a vessel and manages it and its related matters while the vessel is navigating and carrying goods or performing services for freights or hire. Thus, he is the appointed and retained commander of a vessel in commercial service and is the person who is responsible for a vessel in navigation and licensed by competent national authority (and not rejected by the insurers of the hull and liabilities occurring in the maritime venture). (…) In general terms, a master is a qualified seafarer in command of a ship"[58]

U.S. Code title 46 has a definition of "master" as "*the individual having command of a vessel*".[59] A United States Court of Appeals decisions held that "*a [m]aster is not one in name alone. He is [m]aster in fact and commander of a ship…*".[60]

There are also national laws that define the master as any person to whom the authority of the vessel is transferred to or who effectively exercises that authority, anyone instructed with the command of a vessel or who effectively exercises that command, as well as any person who replaces him.[61] Hooydonk points out that these definitions are aimed at the situation in which a captain becomes unavailable for one reason or another and is replaced by another officer, but they could be in principle applied to the new situation of unmanned shipping.[62] If a person with no qualifications to be the shipmaster

[56] Cartner – Fiske – Leiter 2009, p. 3.
[57] Black's law dictionary 1990, p. 975.
[58] Cartner – Fiske – Leiter 2009, p. 3.
[59] 46 USCA § 10101 (1996).
[60] Saskatchewan Gov't Ins. Office v. Spot Pack, Inc, 242 F.2d 385 (5th Cir. 1957).
[61] See eg 46 U.S. Code §10101(1); UK Harbours, Docks and Piers Clauses ACT 1847 s 3; the French Code des Transports art L5511-4; the Belgian Law (3 June 2007) art 28, 4º.
[62] Hooydonk 2015, p. 413.

can still in practice be the shipmaster, the requirement for proper qualifications does not seem to be absolute anymore.

The definitions seem to revolve around the same concept: The Master is the qualified seafarer in command of a vessel. The definitions does not seem to concentrate on the master having to be on the vessel. While the notion of the master having to be on the ship is mentioned, it by no means seems to be the focus point. The other definitions offered here only point out to the command of the vessel, though the master being on the ship is implied. It was undoubtedly never necessary to point it out explicitly that the master is supposed to be on the ship, since the concept of the master has evolved throughout the ages with the same elements: command of the vessel and location of the person being aboard.

Definitions aside, STCW requires the officers in charge of the navigational bridge to be physically present on the navigating bridge or in a directly associated location at all times.[63] This regulation seemingly creates an obstacle for having something like a ship-master on the SCC instead of on the ship. There is however a possible way of complying with the rule. While the SCC chief operator is clearly in charge of the navigational bridge, the question gets easier if the navigational bridge is indeed understood as an analogy to the SCC.

By only looking at the wording of the definitions that are used to describe the shipmaster we can fairly easily see that the SCC chief operator somewhat fits the requirements of a shipmaster. but just by the concept fitting the wording does not yet solve the question whether the regulations that govern the master could or should apply to the SCC chief operator. Regulative instruments need to be taken a look at and the meaning of the regulations analysed to see whether they can and should be applied to the new role of the shipmaster in the SCC.

In this chapter I have analysed the definitions of a shipmaster in law and in conventional vernacular. I have shown that the shipmaster should be understood through its elements of commanding the vessel, having the proper qualifications and being a seafarer. The notion of having to physically be present on the vessel doesn't seem to be in focus. In the next chapter I will examine what a seafarer is and whether the SCC chief operator

[63] STCW, Reg. VIII/2.

could be taken as one. From thereon I will examine what commanding a vessel means and whether the SCC chief operator fulfils this requirement. The qualifications will be discussed in the later chapter about the STCW convention and the STCW code.

3.2 SCC Chief as a seafarer

To be able to analyse whether the chief operator of the SCC can be analogously assimilated into the concept of a conventional seafarer, understanding the term is of the essence.

The term "seafarer" has been defined in the dictionary of shipping as "Shipboard crew personnel involving ship's officers and seamen/ratings"[64]. Black's law dictionary elaborates on the term as follows:

> "a person who is attached to a navigating vessel as an employee below the rank of officer and contributes to the function of the vessel or the accomplishment of its mission. (…) Also termed crew member, mariner, member of a crew. (…) The performance by a vessel of some other mission, such as operating as a cruise ship, necessitates the presence aboard ship of employees who do not 'man, reef and steer' the vessel …. Exploration for oil and gas on navigable waters has led to further expansion of the concept of a 'seaman."[65]

J.R. Fox's dictionary on the other hand defines "seafarer" as "a person who by national law or regulation is deemed competent to perform any duty which may be required of a member of the crew serving in the deck department"[66]. The terms "seaman", "mariner" and "member of the crew" are used as equivalent terms to the term "seafarer"[67]. The term "crew" seems to include the Master, officers and ratings on a vessel[68], the members of ship's company below the rank of a ship's officer[69], and persons assigned by a carrier to serve on a ship, aircraft, barge or truck and listed as such[70].[71]

The term has also been defined in many international labour conventions. The Tripartite Subgroup of the High-level Tripartite Working Group on Maritime Labour Standards (STWGMLS) summarized in its report on duplicative or contradictory text in the existing maritime instruments of the ILO from its second meeting on 24-28 June 2002, that:

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[64] Branch – Branch 2005, p. 301.
[65] Garner – Black 2009, p. 1468.
[66] Fox 2003, p. 294.
[67] Black 1990, p. 426.
[68] *Ibid.* p. 83.
[69] Brown 2005, p. 151.
[70] Black 1990, p. 83.
[71] Lielbarde 2017, p. 4.

> Sixteen Conventions define "seafarer" (seaman) with three pairs of them – Conventions Nos. 22 and 23, 70 and 81, and 164 and 166 – providing the same definition. Therefore, there are 13 different definitions of "seafarer" in the maritime Conventions of the ILO. The various definitions of "seafarer" serve the different goals and scope of the individual Conventions, and vary widely. The variety of the definition relates essentially to the range of exclusion of vessels on board which seafarers are employed.[72]

A definition in the Unemployment Indemnity (Shipwreck) Convention states that the term "seaman" includes all persons employed on any vessel engaged in maritime navigation[73]. The Seamen's Articles of Agreement Convention states that "the term seaman includes every person employed or engaged *in any capacity on board any vessel* and *entered on the ship's articles*. It excludes masters, pilots, cadets and pupils on training ships and duly indentured apprentices, naval ratings, and other persons in the permanent service of a government"[74]. Both of these conventions are still in force and were taken into consideration during the MLC drafting process[75].[76]

In later conventions the term "seafarer" is defined as any person who is employed in any capacity on board a seagoing ship to which the conventions apply[77]. A slightly different definitions can be found in the Recruitment and Placement of Seafarers Convention, which states that "the term Seafarer means any person who fulfils the conditions to be employed or engaged in any capacity on board a seagoing ship".[78]

In her research paper about the term S. Lielbarde analysed that:

> "Although the definitions of "seafarer" under different existing labour conventions are slightly different the main criterion for a person to be considered as a seafarer is their work on board a ship to which the convention applies. Additionally sometimes other criteria are mentioned (e.g., work in the deck department, entered in the ship's articles). The content of many ILO conventions primarily speaks to the employment situation of personnel involved in some way in the operation of the ship – the "crew".[79]

ILO conventions deal primarily with the labour of seafarers, which makes it understandable that the term "seafarer" is defined through the employment situation and the work on board done by the worker. Similar type of logic in understanding the term in IMO

[72] STWGMLS (first meeting), 24-28 June 2002. Duplicative or contradictory text in existing maritime instruments. ILO Doc. No. STWGMLS/2002/4, p. 1-2.
[73] Unemployment Indemnity (Shipwreck) Convention, 1920 (No. 8), Art. 1 (1).
[74] Seamen's Articles of Agreement Convention, 1926 (No. 22), Art. 2 (b).
[75] MLC, Article X.
[76] Lielbarde 2017, p. 4.
[77] Health Protection and Medical Care (Seafarers) Convention, 1987 (No. 164); Repatriation of Seafarers Convention (Revised), 1987 (No. 166); Labour Inspection (Seafarers) Convention, 1996 (No. 178).
[78] Recruitment and Placement of Seafarers Convention, 1996 (No. 179), Art. I (1) (d); Lielbarde 2017, p. 4.
[79] Lielbarde 2017, p. 5.

instruments is reasonable, however. The MLC has been designed to complement the key conventions of IMO as the "fourth pillar" of international regulatory regime for quality shipping[80]. In this regard the convention does not stand apart from the global regulatory framework of international maritime law.

The definition of "seafarer" can also be found in IMO instruments. In SOLAS the crew (seafarers) of the ship is defined, as opposed to passengers, as "the master and the members of the crew or other persons employed or engaged in any capacity on board a ship on the business of that ship"[81]. IMO Casualty Investigation code defines "seafarer" as "any person who is employed or engaged or works in capacity on board a ship. A definition that is used in other IMO instruments as well such as the STCW, although in many cases implicitly[82]. This same definition is reflected in the STCW adoption documents of various flag states[83].

Lielbarde points out that the intention of the MLC drafters was to apply the convention also to persons working on board passenger ships for extended periods, such as cabin stewards, sport instructors and beauticians, even if they were not engaged in the safe operation of the ship.[84] Because the intention was to extend the applicability of MLC to different occupational groups, the General Conference of the ILO adopted resolution VII concerning information on occupational groups to provide member states with guidelines which can be taken into account in deciding to grant seafarer status to a specific occupational group or not[85]. The guidelines are meant only for assisting the interpretation of Article II (I) (f) of the MLC, the final decision being left to the member states.[86] In granting seafarer status the following issues should be considered:

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[80] *Ibid.* p. 1.
[81] Art. II.2 (e) SOLAS; Deketelaere 2017, p. 39.
[82] Section A-VI/1 (2) STCW Code: "seafarers employed or engaged in any capacity on board ship on the business of that ship as part of the ship's complement".
[83] Part I 2, Shipping (STCW Convention) Regulations 1998, GS 4 of 1998, Shipping Act, Tonga; Regulations Regarding Standards of Training, Certification and Watchkeeping for Seafarers, Part 1 1.5, Division of Marine Transportation, Department of Transportations & infrastructure, Government of the Federated States of Micronesia.
[84] Lielbarde 2017, p. 8-9; 94th (Maritime) Session of the International Labour Conference, Geneva, 7-23 February, 2006; Reports and documents submitted to the ILC, 94th (Maritime) Session, 2006; Report I(1A), adoption, of an instrument to consolidate maritime labour standards, p. 15 (Note 3 (Article II (5)).
[85] Resolution VII, Resolution concerning information on occupational groups adopted by the 94th (Maritime) Session of the ILC, Geneva, 7-23 February, 2006.
[86] Lielbarde 2017, p. 9.; Art. II (2) (f) MLC: "*seaferer* means any person who is employed or engaged or works in any capacity on board a ship to which this Convention applies".

(i) the duration of a person’s stay on board;
(ii) the frequency of periods of work spent on board;
(iii) the location of a person’s principal place of work;
(iv) the purpose of a person’s work on board;
(v) the protection that would normally be available to the persons concerned with regard to their labour and social conditions to ensure they are comparable to that provided for under the convention.

Two relevant elements are found in these definitions, as well as in the interpretation guide. The first being the location of the person, or in other words, whether the person is working aboard a ship. The second element relates to the type of work the person does, if it is about operating the vessel or doing something else on it. The definitions seem to put the most emphasis on the locational aspect while giving much more leeway to the nature of the work: a person is a seafarer if he works on a ship, regardless of whether his work pertains to operating it. This is understandable when one looks at what working on a ship entails.

The number of hazards of working on a vessel are much higher than those of working ashore. A seafarer faces the perils of the sea and has to execute all his work and free time aboard. A seafarer is working, sleeping, living and socializing on the ship in a multinational crew with unknown people from different cultures and nationalities, and they need to travel through multiple seas, different time zones, changing climates and contrasting weather conditions. The everyday life of a seafarer takes place in a lonely and potentially hazardous environment with several disturbing factors such as vibrations, sea motion and noises.[87]

The SCC crew on the other hand is situated ashore. Their working environment can be considered luxurious compared to the crew working aboard a ship. For the sake of not working on the ship I would argue that it would not be reasonable or realistic to assume that the SCC crew, or the chief operator for that matter would gain the status of seafarers. The fact that they oversee and operate the autonomous vessels would not justify them the status for the simple reason that their working environment is that of other land-based workers. As Hooydonk states it:

> “The seafarer’s status is based on the specific characteristics of being employed at sea, which include a markedly international environment, physical fitness requirements, safety risks,

[87] Blanpain – Dimitrova 2010, p. 27; Deketelaere 2017, p. 39.

> discipline, long-term presence at the place of work and the commensurate absence from home with limitations on family and social life, and the possibility of a physical transfer to another ship. A shore-based vessel controller does not have to face any of these factors. It is difficult to think of a valid reason why his employment should be governed by the specific rules of maritime law.
>
> On the other hand a number of responsibilities that are currently incumbent on the master and his officers will inevitably be shifted to the shore-based controller."[88]

In this chapter I have argued that the SCC chief operator could unlikely be seen as a seafarer, because what seems to be in the core of the concept is being physically in the marine environment. But even if the SCC chief operator would not be seen as a seafarer, it does not seem to cause an immovable regulatory barrier, because being a seafarer doesn't seem to be in the core of the concept of a shipmaster. A regulatory barrier is however caused by the fact that the shipmaster is defined as a seafarer in national and international regulatory instruments. The issue then is in the language used instead of the real life concepts behind the regulatory instruments.

In the next chapter I will analyse the control concepts of "direct control" and "command" to make sense of these different modes of controlling a vessel and what it means to be in command, how control of the subject is lost and what are the important elements in identifying the commander and the direct controller of a vessel.

3.3 In direct control or in command? Elements of control in R&A operations

3.3.1 The elements of control

To be able to appropriately understand the nature of the responsibilities accorded to the different roles in a R&A operation we first need to clarify the control elements of operating a vessel. This helps us to distribute the responsibilities of old roles to the new players in the field, so to speak. The elements discussed here are "direct-control" and "command", being actually two different types of control when it comes to using the correct terms. We do this to make a case for attributing a correct analogy to the proper new actor in the ROC. To elaborate, we do this to see who closest resembles the master and the officer in charge of navigation in ROC in the different manning setups during each individual control state. By doing this we are able to make a stronger case for using an analogy when attributing the rights and duties of a shipmaster to the ROC captain. Furthermore, many national maritime codes define the shipmaster as the person who

[88] Hooydonk 2015, p. 413.

is in command of a vessel, which makes identifying the command element in the ROC crew a task of great import.

Defining the terms is key. Merriam-Webster dictionary defines “control” in the layman’s vernacular as “to exercise restraining or directing influence over” and “to have power over”.[89] Black’s law dictionary does not have anything under “control”, but “under control” refers to a situation where a person is in charge and in control of a vehicle.[90] The free dictionary by Farlex offers the most concise definition of control as “the power to direct, manage, oversee and/or restrict the affairs, business or assets of a person or entity”[91]. What is shared in these definitions is the fact that an entity has power over its control subject to degree its actions, be they to act or refrain from acting. To my knowledge “control” has been considered in the field of law when it comes to children, pets, employees, vehicles and companies, among others. These definitions are made inside the specific segments of legislation in question and thus are not meant to and probably would not work outside them. It also seems that “control” has not been defined generally in the legal vernacular, which leaves us to use the general definitions. Here we will then use the general layman’s understanding of control.

Two different types of control can be found in the system of how a traditional ship is operated. The first type is called “*direct control*”, which refers to who is closest in practical control of the vessel in real time. In a traditional scenario the person who currently navigates the vessel by his own hand is in control. Over-simplification is something to be avoided, however. Direct control is not only about directly controlling the vessel in a specific situation. I argue that direct control can be fulfilled by supervising and being able to instantly take control of the controlled entity. Such would be the case when the vessel is sailing on autopilot with a person working as a look-out. The person then is in control, because he has situational awareness, understands what is going on and is able to assume direct control when necessary. Choosing not to assume direct control while still being able to do so is still control, as what is meant with “refraining” in the definitions. Here control is lost when the subject of control does something unexpected, when

[89] Merriam-Webster Dictionary.
[90] Black’s Law Dictionary Free Online Legal Dictionary.
[91] The Free Dictionary by Farlex.

the controller is no longer able to assume control, or when the controller ceases to have situational awareness of the control subject.

Control needs these elements of situational awareness i.e. real-time information about the control subject, and ability to assume control, and control is lost when even one of these elements is compromised. In the first situation where control is lost the operator is controlling the vessel but loses the visual feed from it while the controls still work. The operator then has no situational awareness of the subject while still being able to control it directly. Control is lost because the controller does not have the correct information to make a proper control decisions. The same situation is at hand when the vessel is navigating under supervision, but the controller who refrains from directly controlling the vessel is occupied with some another issue. He then does not have the proper information anymore and cannot judge whether he should refrain or assume control. Liability may occur if the person lacks situational awareness because he is for example watching television while he should be supervising. The second situation where control is lost is when the ability to assume control is lost or disrupted. These situations are twofold. The first one is when the control systems malfunction, making it impossible for the controller to control the vessel in any way. The other is when the vessel merely does something unexpected. In the latter case control is lost only for the duration of time that it takes for the controller to assume control and correct the trajectory of the vessel, while in the former situation control is lost in a more permanent way.

The second type of control in ship operation is “command”. It pertains to who can make the decisions, or rather who can legitimately exert influence over the direct controller of the ultimate control subject. It could be seen as an indirect form of control. It differs from direct control in the controller not doing the required action themselves but commanding it and possibly guiding it. The position can be likened to one where the boss of a company gives the employee an objective that he has to achieve by his own capacity. Command is higher in the control hierarchy while control flows from it into direct control that gets limited by it.

“Command” is defined in the Merriam-Webster dictionary as “to exercise a dominating influence over: have command of: to have or exercise direct authority: to give orders:

to dominate as if from an elevated place", among others in the same line of thinking.[92] Black's law dictionary does not have an entry for "in command", but has perhaps a more usable one in the entry about "authority": "The lawful delegation of power by one person to another (…) a right to command or to act".[93] The important element here are that command seems to be a type of control that relates to controlling the actions of a living person. It is still control, but not direct control as is. To be in command seems to be about being in a position to have the right and the duty to give commands and orders to another person who then has to execute them.

In a conventional vessel the person in command is the shipmaster, as he is the person on top of the command chain from who all the powers and authorities on vessel are derived from. He has the power to tell the crew what to do and in many cases the duty to do so. He only becomes the direct controller if he personally takes direct control of the vessel's navigation. In this situation he does not lose command unless someone else assumes his status as the master of the vessel. The one in command refers to the one that dictates the acts of the direct controller. The element of command could be associated with the person working as the ROC captain, as he acts as the team leader for the operator that directly controls and oversees the vessel and situationally refrains from exercising direct control.

The element of command requires awareness as well as the capability to effectively make the decisions. The required awareness is not the same as in the element of direct control however, because a person in command is usually not able to process the many direct sources of information at the same time. To do his job as a commander he needs to be able to trust his underlings to give him the relevant information for effective decision-making and to do the tasks allocated to them as instructed. The commander is "in command" because he is the one that gives the tasks to the people that carry them out. He may also delegate parts of his authority to his underlings, but this does not ultimately rid him of the authority, rather it is then channelled from the source to the receiver. *De facto* command is likewise lost if the information he gains is incorrect or missing, or if he is unable to give out the orders to the direct controllers, or if the direct controllers do not obey him or carry out the tasks in a way not intended. One must also be conscious

[92] Merriam-Webster Dictionary.
[93] Black's Law Dictionary Free Online Legal Dictionary.

of the fact that a command chain is exactly what the name suggests: a chain. If the direct controller loses control of the subject and thus breaks the chain, the commander loses command of it as well. Liability can be caused by not having command when one ought to have it.

A somewhat analogous elements of control and command can be found in the levels of responsibility found in the Section A-I/1 of the STCW Code:

> ".2 *Management level* means the level of responsibility associated with:
>
> > .2.1 serving as master, chief mate, chief engineer officer or second engineer officer on board a seagoing ship, and
> >
> > .2.2 ensuring that all functions within the designated area of responsibility are properly performed;
>
> .3 *Operational level* means the level of responsibility associated with:
>
> > .3.1 serving as officer in charge of a navigational or engineering watch or as designated duty engineer for periodically unmanned machinery spaces or as radio operator on board a seagoing ship, and
> >
> > .3.2 maintaining direct control over the performance of all functions within the designated area of responsibility in accordance with proper procedures and under the direction of an individual serving in the management level for that area of responsibility;"[94]

Here the levels of responsibility have been defined through the level of control as well, as the person in the operational level maintains direct control of the functions while the person in the management level is the one ensuring that the functions are performed. What is important to note from the section in the STCW code is that the idea of different types of control can be found written into the instrument, which shows that this type of thinking exists in the regulation already.

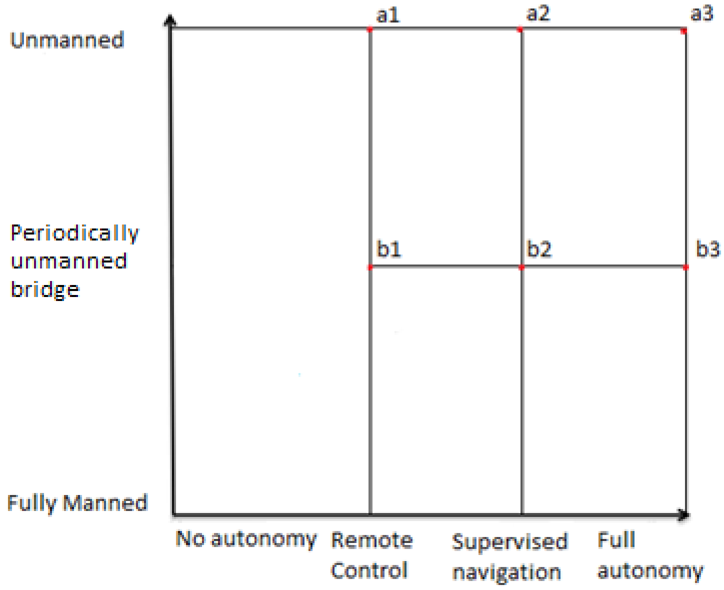
As shown above, "direct control" and "command" are two different types of control. These two types of control can be located in the navigational system of conventional vessels as well as in R&A vessels by analysing the different combinations of levels of manning and control states. In the next section these situations are considered to identify the person or entity that makes the direct navigational decisions and the person or entity that gives the tasks to the direct controller. Being in command of a vessel seems to be to most important requirement for a person to be understood as the shipmaster, as the shipmaster is most commonly associated as the person being in command of the vessel. First I will set the rules of the analysis, from where I will move on to analysing the

[94] STCW Code A-I/1.

first set consisting of unmanned vessels in different control states, after which I analyse the second set consisting of manned vessels with periodically unmanned bridges. After the analysis I state my conclusions for the analysis and for the whole chapter.

3.3.2 Setting the analysis

In this section I outline the analysis to be able to understand the elements of direct control and command in different compositions of the vessels manning and the different control states proposed by Rolls-Royce Marine. The table for the scenarios is shown below:



The table highlights the different variations to manning and control states in specific situations. The vertical axis depicts manning and location of the crew in three different predefined categories. The vessel is either fully manned as conventional vessels are, the bridge is periodically unmanned as in when the vessel has less personnel than it would conventionally require because the “missing” personnel are substituted by the ANS and having the ANS take care of the navigational duties periodically, and unmanned where the vessel has no crew aboard at all and all the navigational tasks are carried out either by the ANS or remotely from the ROC. The horizontal axis depicts the different control states of the vessel with varying level of autonomy. While the manning of a vessel is conventionally somewhat fixed and usually not varying at all during a voyage, the control states can change from one moment to the next.

Control states is a term coined by Rolls-Royce to depict who, what and how a vessel is controlled. The key elements in these states are a) who or what makes the decisions, and b) who is in direct-control and who is in command. Rolls-Royce uses three different control states in their R&A model:

- Remote control mode
- Supervised navigation mode
- Fully autonomous mode

The situations that emerge while at sea are of a multitude. The analysis then changes according to different problematic situations, such as routine navigation, unexpected navigational situations and salvage situations. Every situation has different interests and aspects to them, and different compositions and control states are better suited for dealing with different situations of the voyage. In this analysis the situations that seem the most problematic are discussed when necessary. The most interesting questions arise when the situation is something else than routine navigations, which are also the situations that are most heavily regulated.

A conventional vessel is operated manually with a person on board the ship making all the decisions, albeit automation assists in carrying out these decisions in most of the cases. The decision making lies with a human who is situated on board the vessel. In a remotely operated vessel a human is still making all the decisions and directly controlling the vessel in real time, but the human operator is in a remote location and not on the vessel. Supervised navigation on the other hand leaves the decision making to the vessels computer systems, while a human is still supervising the navigation through the audio-visual sensors of the vessel, ready to step in and exert control whenever needed. Supervised navigation can be carried out from on board the vessel and off it, the key element being that the vessel is the one making decisions while the human is left to supervise. In fully autonomous mode the vessel carries out the operation on its own without direct supervision through its audio-visual sensors. The vessel could still be supervised for the ROC in a more limited fashion through its GPS and related systems.

Control states in a R&A operation are not fixed in place. It is imagined that an autonomous vessel could be remotely controlled for example when leaving port or navigating in a busy archipelago area. The vessel could then be set to autonomous navigation mode when moving to high seas, and set to supervised navigation if something occurs that warrants the supervision of the operator. It is likely that when in high seas, such as when crossing the Atlantic Ocean, the vessel would function in fully autonomous mode with no need for supervision. Levels of autonomy are then understood as being dynamic.[95]

Manning of the vessel on the other hand is somewhat static. SOLAS Regulation V/14 and its associated guidelines on safe manning[96] leave the decision of defining a safe manning level per ship to the flag state administration. Once the administration decides on the number and qualifications of the crew are insufficient, it will issue a safe manning document for the ship. The document then sets the minimum level of manning for that particular ship that cannot be deviated downwards from. The ship may be manned with more and better qualified crew, but not less than what is stated in the manning certificate. The level of manning on a ship, once decided, is thus likely to stay much more static than its level of autonomy.[97]

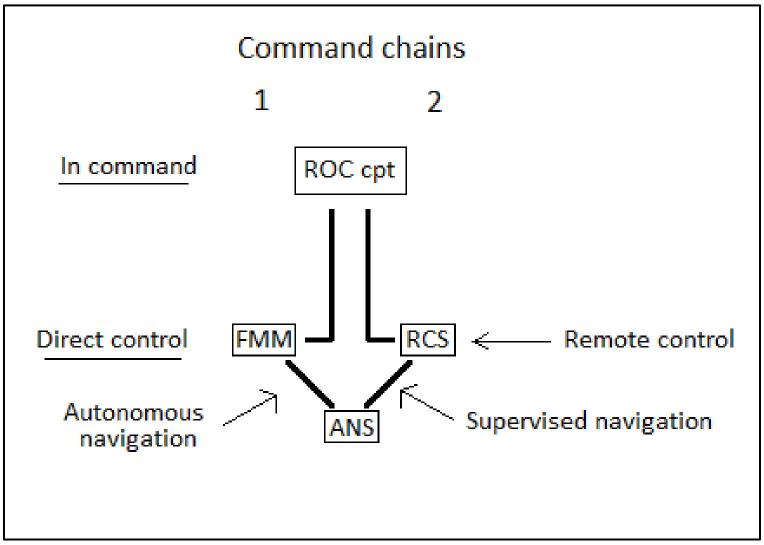
The analysis is done by going through all the six scenarios and identifying who is in direct control and who is in command in the scheme. Each situation is first defined and elaborated to give a more practical understanding of what it actually looks like. Then the focus is turned on the elements of direct control and command with their accompanying arguments.

3.3.3 Analysis: Set *a* –Unmanned vessels

Scenario set *a* concerns unmanned vessels. The vessel has no crew aboard and its operation is done from the SCC. Scenario set *b* concerns vessels with periodically unmanned bridges. To make the analysis clearer the constructed model of the vessel consists of only one crew member, because the most interesting questions emerge when the last person leaves the vessel. This scenario reflects the probable future because it is likely that the autonomous systems are going to be first retrofitted into traditional vessels. These types of vessels undoubtedly need maintenance and care on board, even if all the navigational tasks would possibly be executed autonomously. The person on the vessel takes care of the maintenance and other tasks that might arise. He might also be called to navigate the vessel if the autonomous system needs human intervention, not to mention the application of the "bridge zero" concept.[98] A vessel might also be retrofitted

[95] Anton Westerlund, 28.9.2018.
[96] *See* IMO Resolution A.1047(27).
[97] Ringbom 2018, p. 16-18.
[98] Markus Laurinen 3.1.2018.

with the ANS just to enable the "bridge zero" way of operating. The owner of the vessel might then not have any need for remote control services, so in this situation there is no ROC that could assume any type of control of the vessel. This situation is considered in lieu of scenario b3 because it reflects this situation the closest. The only variation is that there is no possibility of "control hop" to ROC. As a reminder, the control state of the vessel flows from one state to another during the voyage and depending on the circumstances, which causes the direct control element to change from one person to another. A table is provided below to provide clarity for the following analysis.



The table depicts two types of command chains relating to the different control states. The ROC captain is always in command of the vessel. When the vessel is in remote control state, the RCS operator is the one in direct control of the vessel. When the vessel is in supervised navigation, the RCS operator is in direct control through supervision as the ANS makes the navigational decisions. The other chain of command is used when the vessel is in autonomous navigation mode, where the FMM operator supervises the vessel and thus has direct control of it while the ANS makes the navigational decisions.

The setting that these scenarios are reflected on is that of a conventional vessel. A vessel has a shipmaster who is in command. The operator navigating the vessel is the one in direct control. The vessel is fully manned and operated with a person in the decision making loop. ROC on the other hand has the ROC captain as the commander and an RCS Operator as the controller. The RCS operator operates the vessel and situationally asks for instructions from the ROC captain that acts as the commander of the vessel. The

FMM Operator is in charge of the strategic elements of the operation without ever taking direct control of the vessel.

In scenario *a1* the ship is unmanned and remotely controlled. The RCS operator in the ROC is in direct control of the vessel and the ROC captain is in command, because he is the one who has the authority to dictate the actions of the RCS operator. None of the decisions are done by the vessels' ANS and the situation is analogous to navigating a conventional vessel, the only difference being that the operating is done remotely. Here the ROC captain could easily be likened to a conventional shipmaster and the RCS operator to a conventional crewmember on navigational duty. The ROC captain keeps command only as long as he has the authority and control over the direct controllers, and has the proper knowledge to be able to exert his authority when needed. This means that if the ROC captain goes away from the ROC, he maintains command only if he is kept as the designated person for commanding the vessel. The situation is similar to a conventional shipmaster going to sleep in his quarters. The ROC captain also needs to reachable at any time if something occurs that needs his attention. The situation is different from a conventional vessel however, because in the ROC the ROC captain is not "married to a ship", which allows a different ROC captain to step in and assume the role of the master when the other one needs to leave or becomes unavailable. In situations of overlapping and changing of command it should be clearly stated who has the command.

In scenario *a2* the vessel is unmanned and continuously supervised through audio-visual and other sensors. The ANS makes the navigational decisions while the RCS Operator is fully aware of what the vessel is doing in real time and can assume control whenever necessary. Here the necessary elements of knowledge and ability to take direct control are fulfilled. The ROC captain is still in command. The situation differs from the last one only in the sense that the direct controller is refraining from actively exerting his control over the control subject, which is the operated vessel. As stated in an earlier part of the thesis, control is not lost just by the controller choosing to refrain from using it. Direct control and command are kept as long as supervision and the ability to take direct control is maintained.

In scenario *a3* the vessel is unmanned and fully autonomous. The vessel is navigating on its own with no direct supervision. Direct control is only assumed when the ANS sends a prompt to the ROC Crew to take a look at what is happening, for example when it doesn't identify an important object or cannot execute its programming in a proper way. In this scenario the autonomous navigation system of the vessel is technically in direct control, for while the ability to take control is still with the RCS operator, there is no direct real-time feed from the vessels sensors as there would be during the supervised navigations -state. However the one in direct control seems to be the FMM operator if he is supervising the vessel closely enough. The one in command in this state is the ROC captain as long as the operators fulfil the requirements of having control, thus keeping the command chain intact.

While there is no direct information through the sensors of the vessel, a limited type of supervision will be, and in my opinion should be continuously kept, for example through monitoring the conning and GPS information of the vessel on a screen by the FMM operator, aided by the ANS prompt function. This way some kind of situational awareness is upheld at all times to prevent the possibility of losing control of the vessel. The ANS prompt function wouldn't be the only fail-safe system to monitor the vessels autonomous operation, and a human would always be somehow kept in the decision making loop, if not in strictly navigational decisions then at least in strategic decisions. In my opinion the limited supervision proposed here should also have a limited number of vessels for each FMM operator. If all the operated vessels are displayed in one large screen, not one of them will be the proper focus of the operator's attention. The number of vessels displayed and supervised through the monitors should be limited to give the FMM operator the proper focus to notice disparities. This way the situation would be similar to supervised navigation where direct control is kept by supervision and refraining from exerting control. The way of supervision just changes into a more indirect form and from including only one vessel into including many.

In this scenario the ANS makes the navigational decisions. The situation is similar to a shipmaster delegating his navigational powers to a deck officer. Only in this situation the deck officer (the FMM operator) delegates the navigational powers further to the ANS. In a conventional vessel the shipmaster does not always have direct knowledge of the situation or control of the navigation, he might be away from the bridge and/or sleeping, and he must be able to trust the capabilities of the person entrusted with navigation. To put it simply, on the vessel it is the master who is responsible for any accident caused by navigation[99], but he is able to avoid liability if the actual reason for the accident was for example the lack of good seamanship skills or bad judgment of the navigator. This logic probably does not apply as it is with autonomous vessels, however. When navigation is in the hands of the ANS but the command rests on the ROC Captain, the liability for a collision shouldn't be avoidable just by simply attributing the navigational responsibility to the ANS, from where liability would possibly be attributed to the systems manufacturer. If an incident is not cause by *force majeure*, liability always needs to be attributed to a living person. The issue is discussed further in the AAWA whitepaper, where it is argued that the liability in these situations might be attributed to the systems manufacturer.[100]

However, my argument is that when an accident occurs while the vessel is or should be supervised and no problems with assuming control are present, all rationality says that liability should stay within the SCC crew and their employing company instead of being attributed to the manufacturer. A problem for this type of reasoning seems to be the strict liability regime of the product manufacturer in the European Union, the result of which is that the product manufacturer is liable for any damages caused by his product, no matter the level of negligence[101]. This might mean that technically the shipmaster could put on the ANS system just before the collision to automatically move the liability to the product manufacturer, because control was technically with the ANS during the collision. A better system might be something where the system manufacturer is able to evade liability by showing that the system worked as intended and was not the real cause of the accident, instead of being liable "automatically".

3.3.4 Analysis: Set *b* – Periodically unmanned bridge

Scenario set *b* refers to a vessel with a periodically unmanned bridge, equipped with an ANS. This scenario enables the solution referred to as "bridge 0" (B0). The system follows the logic of the "engine 0" (E0) solution where automation is used to reduce the manning time of the engine department during more passive situations. In B0 the manning would similarly be reduced on the bridge for the more passive parts of the voyage by letting the ANS do the watchkeeping and navigation during the calm situations. During

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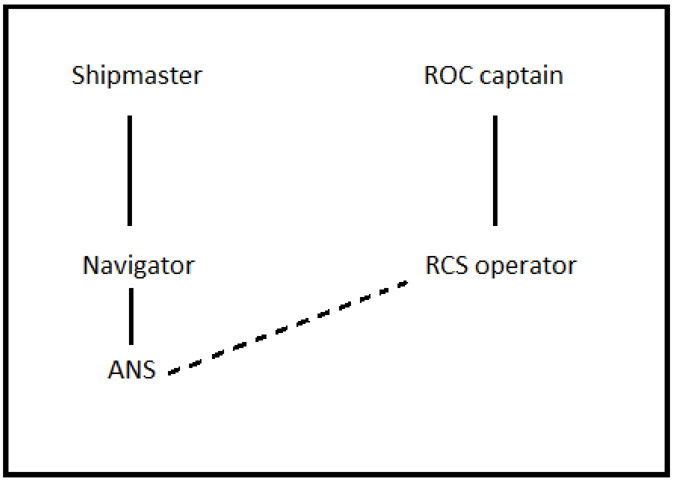
[99] Here I am talking about the responsibility inside the vessel-entity. The starting point overall is still that the shipowner is responsible for the masters actions done on his behalf.
[100] *See* AAWA Whitepaper.
[101] *See* Directive 85/374/EEC *and* Directive 1999/34/EC.

this time the ships master and officers would also be liberated to use their time more productively than staring at the horizon. There would be an Officer on Watch (OOW) ready to take control when needed, just as in the B0 solution. This type of setup seems to be the most likely first setup on the road to proper R&A operations, as the ANS could be retrofitted on existing vessels to decrease manning costs without putting funds to a remote operating setup.[102] Furthermore, the legal hurdles involved will be understandably less complex, because the vessel would not become totally unmanned.

In this setup the ship can either be connected to a ROC or not, depending of for example whether the remote control service has been bought for the ship or not. In the former situation the ROC is able to supervise and take control of the vessel remotely, even if there is a crew aboard. In the latter case the crew on the vessel is the primary crew and there is no ROC involved in any way. Having a manned bridge with a connection to a SCC opens up a possibility of "control hop", where the chain of command and control shifts from the crew aboard the vessel to the ROC crew ashore. The chain of command and direct control is then as in the table below.



On the left side the shipmaster is in command while the navigator physically on the vessel is in direct control. The navigator would be in direct control as well when the ANS is making the navigational decisions, as long as he is supervising. If a ROC is connected to the vessel, the command chain would hop to the ROC command chain when an RCS operator takes control of the vessel. Then the ROC captain would be in command while the RCS operator is in direct control. A systematic issue however is that when there are supervisors on the vessel physically as well as ashore at the same time, a situation might

[102] Anton Westerlund, 28.9.2018.

occur where the vessel has two masters at the same time. This type of situation however is not recognised in regulation.

On a vessel connected to a ROC the control would be in the hands of the crew aboard initially, but could be shifted to the ROC crew for example when there is need for piloting, or if the crew members aboard were for one reason or another unable to take control of the ship. The opposite way of control is certainly possible, where the ship is controlled from the ROC mainly while the aboard crew only takes control of the vessel when needed. This is the more reasonable scenario in the short term, because it allows for safer testing of the R&A operations without losing the security that an aboard crew brings to the operation.

In scenario b1 the bridge is periodically unmanned and the vessel is remotely controlled from a ROC. Direct control is with the RCS operator and command with the ROC captain. This situation would come about when piloting services are executed from the ROC, or if the person on the vessel was unable to assume control, such as when the manual control systems on the vessel malfunction or the person aboard becomes preoccupied. This situation is practically analogous to the situation where the operator physically on the vessel is controlling the vessel, albeit only different in spatial respect.

In scenario b2 the bridge on the vessel is periodically unmanned and the control state is supervised navigation. The control is with the person directly supervising the vessel on its bridge. Since the person in this scenario is alone, he is also the master and thus in command. If there were two people aboard only one of them would be the master, which would naturally shift the command only to him. If the owner of the vessel has bought ROC services for the vessel the supervision could be conducted from ashore while the person aboard does maintenance work for example.

In scenario b3 the bridge on the vessel is periodically unmanned and the vessel is sailing on fully autonomous mode. If the vessel is not connected to a ROC the supervision should be somehow conducted. If the person aboard goes to sleep while the control is with the ANS, there is no supervision. This causes the human to drop out of the decision making loop. A possibility is to accept the function where the ANS alerts the crew member to take over when needed as acceptable enough, and this way disregard in the first instance the requirement of having a person in the decision making loop. Another possibility is to have the ship monitored from the ROC while the crew member sleeps, but this is not practical or economical, because it involves a ROC. Furthermore, there is another question when it comes to reaction times. If the system gives an alert while the crew member is on the other side of the vessel, it might take him several minutes to reach the bridge. Reaction times can likely be solved with redundancy systems and technical solutions, but dropping the person out of the decision making loop seems to be the principal problem in the regulatory system. It would seem that more research on this matter is required.

3.3.5 Conclusions of the analysis

For vessels with periodically unmanned bridges the challenges seem to be different than those of unmanned vessels. Where unmanned vessels have the principal issue of having no crew aboard, they can still be designed to have a human in the decision making loop during every leg of the voyage. However vessels with periodically unmanned bridges are manned, but its attractiveness comes from the B0 solution that causes/enables the human to be taken out of the decision making loop. With vessels with periodically unmanned bridges the legal status and requirements of the crew are the same as with conventional vessels, which isolates the issue into the problem of control while having most of the system stay the same, unlike when it comes to unmanning the vessel. The B0 solution seems to reap the greatest interest within the stakeholders[103], as it enables manning to be decreased, it doesn't incur the cost of having a remote operating centre connected to the vessel, and the ANS that makes the solution possible can be installed on practically any vessel without requiring radical modifications to the vessel. Furthermore, other envisioned spin-off benefits arise from using the ANS on these older vessels, such as increased safety in navigation and fuel-efficiency. Further research into this topic seems important, however.

To conclude the analysis, the command element seems to stay with the ROC captain in every control state of an unmanned vessel, but the direct control element shifts from the RCS operator to the FMM operator according to the control state. By changing control states, more control and less supervision is granted to the autonomous system, and this way the number of autonomous vessels under command could be increased. The RCS operator is concerned with only on vessel at a time while the FMM operator steps

[103] Aleksi Uttula, 19.2.2019.

in with different equipment to supervise a greater number of vessels at a time, but does so by dividing his attention between multiple vessels at once. Control and command stay with the captain and the operator as long as connection is maintained, and when it is lost these elements are lost with it.

When it comes to vessels with periodically unmanned bridges the command element seems to stay with the master of the vessel most of the time, as is with control as long as supervision is maintained. When supervision is given away by letting the ANS navigate on its own while the master sleeps or does maintenance for example, the human gets taken out of the decision making loop. This in turn causes the human to not be in control, and to tackle this issue the system would seem to have need for a wide variety of fail-to-safe systems and alarms.

What is shown with this analysis is that in the ROC the ROC captain is in command of the unmanned vessels every step of the way. If the one in command of a vessel is the shipmaster, as many national legislations define it, then the analogy of seeing the ROC captain as the shipmaster can be made on this basis.

3.4 Conclusions

In this chapter I have presented the elements that the status of a shipmaster seems to be made of, these being the proper certifications, being a seafarer and being in command of the vessel. I have then analysed whether the SCC chief operator could be seen as a seafarer or not, and argued that in all likelihood the status of a seafarer could not be applied to the SCC chief operator or the other SCC operators for that matter, because they are physically located ashore. Afterwards I examined what it means to be in command of a ship and presented the two different levels of control related to operating a vessel, namely “command” and “direct control”. I then analysed sets of unmanned and manned vessel compositions in different control states as designed by Rolls-Royce Marine, and came to the conclusion that the ROC captain can be argued to be in command of the vessel in all scenarios and during all control states, as long as control can be exercised on the vessel and the proper real-time knowledge of the vessel is kept at all times. The requirement of proper certifications will be discussed in the next chapter, in the later subchapter discussing the STCW.

4 Shipmasters’ responsibilities and the ROC captain

4.1 Setting the analysis: the system of shipmasters’ responsibilities

In the questionnaire to the national maritime law associations by the CMI was the question whether under the law of the state in question the chief on-shore remote-controller could constitute the unmanned ships master. The majority responded that by definition the master could very well be a person on the SCC, while most of the states that had no definition of the master pointed out that the presupposition that a master is on board a vessel contained in national and international legislation would make the analogy most likely redundant without amendments.[104] There seems to be great uncertainty within the international community about the legal status of the shipmaster being granted to an ashore operator, yet the preliminary idea of how to begin solving this question seems to be generally accepted: the rights and duties of the shipmaster need to be analysed to see whether they could and should be applied to the remote-operator [105], be it the chief of the on-shore crew or the direct-controlling operator.

The method of the analysis is to first define the rights and duties of a shipmaster that are based strictly on written international legal sources. These international conventions and codes that the rights and duties of a shipmaster are mainly derived from and that are therefore used in this analysis are UNCLOS, SOLAS, STCW, Salvage Convention, and the STCW, ISPS and ISM codes. The structure of the analysis starts with a brief introduction to each instrument followed by a presentation of the norms in these instruments relevant to the analysis. From there on the norms are discussed in light of the SCC chief operator. In the end of each section I will discuss the results of the analysis.

Maritime law is a *sui generis*[106]system of regulation. It has elements of labour, transportation, contracts, agency, construction, liability, litigation, insurance etc. These are all things that are also regulated through general systems of regulation applicable ashore. The reasons maritime law is a sui generis system and in many ways separate from the general systems of regulation ashore are its aspect of emphasised internationality and the unique circumstances surrounding the industry. The marine industry concerns itself with matter surrounding the marine environment, a realm fundamentally different from the one ashore. The rules of the marine world are different as well, though much less so

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[104] MSC 99/INF. 8, Annex 1, p. 2-3.
[105] Maritime Safety Committee (MSC), 99th session 16-25 May 2018, meeting summary.
[106] *”Of its own kind; in a class by itself; unique”*.

than in the past. For example, development in communication technologies, such as the satellite phone, has allowed for more ashore-type solutions while on the other hand diminishing the importance of the maritime rules that exist to meet the demands caused by the lack of connection.

Roughly 90% of world trade is carried by the international shipping industry. There are over 50 000 merchant ships trading internationally, transporting every kind of cargo. The world fleet is registered in over 150 nations, and manned by over a million seafarers of virtually every nationality.[107]

The crew of a conventional ship is found in the middle of the marine environment. They are at the mercy of the sea and in the hands of their own capabilities. They need to be in proper fitness and manage their way through the oceans without expecting much outside assistance. This is one of the principal facts that the system of maritime regulation is built upon. Unmanned vessels essentially disrupt this situation by having the crew away from the ship on the SCC. Because the principal fact that the crew is on the vessel changes into the crew being located ashore, there is no longer reason in applying conventional rules to the crew in the same conventional fashion. They get more and more assimilated into the category of normal workers ashore, their only connection to the marine environment being that they remotely operate machines that are actually in contact with the marine environment. Granted, this type of assimilation cannot fully be done because the vessels that are operated are still in a highly international environment, voyaging from one country to the next. In extension the operators have an international connection as well through the vessels, but this connection is much more limited than in the conventional setting where the operator himself is physically travelling with the vessel. None the less, one could carefully liken the SCC operator to a somewhat similar status of a vessel traffic service (VTS) operator, working from an ashore location and overseeing ship traffic from the side lines instead of being in the thick of it. A similar solution is already in use in the aviation industry, where remote air traffic control is conducted through a series of sensors and cameras, enabling the air traffic controllers to be situations potentially anywhere in the world[108]. The ashore crew will still operate the

[107] The Maritime Industry Knowledge Centre – Shipping facts.
[108] The Blue Swan Daily – Remote air traffic control is the future foundation of the air traffic management industry.

vessels but their work environment is different, and for this reason the rules built on the fact that the crew is situated in the marine environment lose their basis in the new setting.

The important thing to keep in mind here is that while the working environment of the crew changes, the essential function of navigating the vessel does not. The SCC chief operator is still in command of navigation, even when systems for autonomous navigation are involved. When the crew is moved ashore there is no more reason for the *sui generis* system of maritime law to govern for example their working environment or their capabilities as agents of the employer. The system to govern the aspects that are not essentially marine in nature should be the same general system that applies to everything ashore. Doing otherwise would result in the IMO or ILO governing land based aspects that are conventionally inside the sphere of national jurisdiction, for the mere merit of having a connection to the marine environment. Just as the work environments of VTS operators are not governed by the ILO or IMO instruments but through national labour legislation, the same aspects of the shore based SCC operators shouldn't be controlled with them either. The other side of the coin is of course that the maritime system should still govern those aspects that essentially *are* marine in nature, such as how a vessel is operated and how to conduct salvage operations. What must be done then is to identify whether the rule governing the shipmaster is based on the fact that the shipmaster in on the vessel, or the fact that shipmaster is in charge of the operating the vessel. This is essentially about changing the principal facts of the conventional setting to the principal facts of the new setting to evaluate whether the conventional rules can be applied to the new role.

The Marine Labour Convention and the duties that it imposes on the shipmaster are left out of this thesis for the reason that the MLC only applies to seafarers. As I have argued in an earlier chapter, it is highly doubtful that the MLC would be applied to the remote operators working ashore, and thus it is also highly doubtful that the shipmasters' duties in the MLC would be applies to the SCC chief operator, even if the status of the shipmaster would be applied to him.

4.2 UNCLOS, SOLAS and the Salvage Convention

The first instrument to be analysed is the United Nations Convention on the Law of the Sea, 1982. The convention is sometimes referred to as the constitution of the seas. The convention comprises all the legal norms pertaining to the sea and applicable to relations between states. It contains rules on the delimitation and exploitation of maritime areas as well as provisions on the protection and exploration of the oceans. The convention draws together the four Geneva Conventions – the "old" law of the sea – in a single unified treaty. As of July 2009, 157 states had acceded to the Convention.[109]

The only rule in the convention that creates a duty for the master, the duty to render assistance, can be found in Article 98:

> 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. [110]

The article creates an obligation for every state to create an obligation for the master to situationally render assistance at sea to those in need. The rule has a goal-based structure and only requires the states to oblige the master to render assistance without specifying how the assistance should be rendered. The first thing to consider is the safety of the masters' own ship, crew and passengers. Assistance needs to be rendered only in so far as it can be done without seriously endangering these own assets. To state the rule simply, the rule requires national legislations to require that the master in their jurisdiction has to assist others in distress at sea.

The rule has in it the presumption that the master is on the vessel physically, but this doesn't seem to cause an issue in the new situation. The rule only requires the master to "render assistance", and to proceed with all possible speed to the rescue of persons in distress in so far as such action may reasonably be expected of him. Rendering assistance means different things in different situations, and the capability of the salvor to render assistance is not specified. An unmanned vessel might not be able to provide as much assistance as a conventional one, yet this does not mean that the rule couldn't apply, because different types of conventional ships have also varying capabilities to render assistance. Furthermore, the rule seems more focused on the masters' role as

[109] World ocean review – Law of the Sea.
[110] UNCLOS art. 98.

the operator of the vessel. The chief SCC operator still operates the vessel, and obligating the states to require him to render assistance within these parameters does not seem to cause a regulatory problem. An important question with this obligation is about how the requirement is formulated in national legislations, which makes it a different question for different states. This obligation in the Finnish Maritime Code is discussed in a later chapter.

The International Convention for the Safety of Life at Sea (SOLAS), 1974 in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships. The first version was adopted in 1914, in response to the Titanic disaster, the second in 1929, the third in 1948, and the fourth in 1960. The Convention in force today is sometimes referred to as SOLAS, 1974, as amended. The main objective of the SOLAS Convention is to specify minimum standards for the construction, equipment and operation of ships, compatible with their safety. Flag States are responsible for ensuring that ships under their flag comply with its requirements, and a number of certificates are prescribed in the Convention as proof that this has been done.[111]

The most important regulations for the master in SOLAS are found in Chapter V, titled "Safety of navigation". The rules creating explicit duties for the master can be found in Regulation 2 concerning danger messages, regulation 7 concerning speed near ice and, most importantly, regulation 10 concerning distress messages. Regulation 2 requires the master to communicate a danger he meets on his voyage to the ships in his vicinity and to the competent authorities, while regulation 7 requires the master to take safety measures when near ice. Even if these regulations create explicit duties for the master, both of the regulations only concern operation of the vessel, and thus seem to pose no regulative problem when applying them to the chief SCC operator.

The important regulation in the chapter is regulation 10:

> "Regulation 10, Distress messages – obligations and procedures
>
> (a) The master of a ship at sea, on receiving a signal from any source that a ship or aircraft or survival craft thereof is in distress, is bound to proceed with all speed to the assistance of the persons in distress informing them if possible that he is doing so. If he is unable or, in the special circumstances of the case, considers it unreasonable or unnecessary to

[111] IMO – International Convention for the Safety of Life at Sea (SOLAS), 1974.

proceed to their assistance, he must enter in the logbook the reason for failing to proceed to the assistance of the persons in distress.

(b) The master of a ship in distress, after consultation, so far as may be possible, with the masters of the ships which answer his call for assistance, has the right to requisition such one or more of those ships as he considers best able to render assistance, and it shall be the duty of the master or masters of the ship or ships requisitioned to comply with the requisition by continuing to proceed with all speed to the assistance of persons in distress.

(c) The master of a ship shall be released from the obligation imposed by paragraph (a) of this Regulation when he learns that one or more ships other than his own have been requisitioned and are complying with the requisition.

(d) The master of a ship shall be released from the obligation imposed by paragraph (a) of this Regulation, and, if his ship has been requisitioned, from the obligation imposed by paragraph (b) of this Regulation, if he is informed by the persons in distress or by the master of another ship which has reached such persons that assistance is no longer necessary.

(e) The provisions of this Regulation do not prejudice the International Convention for the unification of certain rules of law relating to Assistance and Salvage at Sea, signed at Brussels on 23 September 1910, particularly the obligation to render assistance imposed by Article 11 of that Convention[112]". [113]

The rule creates a direct obligation for the master to speed to the assistance of a ship, aircraft or survival craft thereof upon receiving a distress signal. If in any case the obligation is not adhered to, the master must enter the reason for it into the logbook. The rule sets the requirements for the master to be released from the obligation as well. As with the rule in UNCLOS discussed above, this rule concerns operation of the vessel rather than the location of the master. As with applying article 98 of UNCLOS, applying this rule to the chief SCC operator doesn't seem to create a regulatory problem. The rule makes no notion to the capability for providing assistance, only stating that after receiving a distress signal the master must speed to assistance. The fact that the "master" is ashore doesn't bar the application of this rule, nor the fact that the "master" is still able to follow it.

Both of the rules discussed above, UNCLOS article 98 and SOLAS chapter V regulation 10, seem to be applicable in R&A operations as they are. There doesn't seem to be an issue with the location of the crew, rather an issue seems to be caused by the capabilities (or possible lack of) of an unmanned vessel to render assistance in a distress situation. When there are no people on the vessel, let alone any accommodation with systems capable of sustaining a person, the ways of assisting a person or object in distress is

[112] "Every master is bound, so far as he can do so without serious danger to his vessel, her crew and passengers, to render assistance to everybody, even though an enemy, found at sea in danger of being lost. The owner of the vessel incurs no liability by reason of contravention of the foregoing provision".
[113] SOLAS regulation 10.

greatly diminished. This results in a possible diminishing of the practical relevancy of these rules for the chief SCC operator. He might end up possibly only being required to launch a survival craft and a distress beacon when coming up to a distress situation, and the salvee might end up either outright releasing the unmanned vessel from the obligation to assist and categorically choosing a manned vessel as the salvor when possible. This in turn might end up in a situation where unmanned vessel have the same rules in theory but their obligation to render assistance is in practice lesser than what is required from a manned vessel. The extreme case of this is a collision situation with a manned and an unmanned vessel. They both have to help each other, yet the unmanned vessel might be unable to do much. The manned vessel would then be obligated to assist the unmanned vessel without getting any assistance themselves. What this entails for the legal system is a set of rules uniform in theory but with a high variance of practical application that should be accounted for, perhaps by requiring a standard level of salvage capabilities from unmanned vessels. In any case, there doesn't seem to be a principal regulatory problem in applying this rule to the SCC chief operator.

The International Convention on Salvage, 1989, continues with the same theme as the two conventions discussed above. It provides the legal framework for salvage operators by setting an appropriate salvage award for the salvor to intervene in any casualty situation.[114] It also sets explicit duties to the master in its Article 8 – Duties of the salvor and of the owner and master.[115] The duties in article 8 are operational and goal based, obliging the master to for example co-operate with the salvor during the salvage operation, or to carry out the salvage operations with due care. Article 10 repeats what has been stated in UNCLOS and SOLAS about the duty to render assistance[116]. Article 6 of the convention grants the master the authority to create salvage contracts on behalf of the owner of the vessel and the cargo[117]. The convention in itself doesn't seem to cause a regulatory problem either if the legal status of the master is applied to the SCC chief operator.

[114] The International Salvage Union, The legal framework for salvage operators and the 1989 Salvage Convention.
[115] Salvage convention Art 8.
[116] Salvage convention art 10.
[117] Salvage convention art 6.

4.3 STCW convention and code

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 was adopted on 7 July 1978 and entered into force on 28 April 1984. The main purpose of the Convention is to promote safety of life and property at sea and the protection of the marine environment by establishing in common agreement international standards of training, certification and watchkeeping for seafarers.[118]

The regulations contained in the Convention are supported by sections in the STCW Code. Generally speaking, the Convention contains basic requirements which are then enlarged upon and explained in the Code. Part A of the Code is mandatory. The minimum standards of competence required for seagoing personnel are given in detail in a series of tables. Chapter II of the Code, for example, deals with standards regarding the master and deck department. Part B of the Code contains recommended guidance which is intended to help Parties implement the Convention. The measures suggested are not mandatory and the examples given are only intended to illustrate how certain Convention requirements may be complied with. However, the recommendations in general represent an approach that has been harmonized by discussions within IMO and consultation with other international organizations. [119] Only part A of the code is taken into the analysis, as its rules are mandatory.

The convention defines the master as the person having command of the ship. In this sense the convention would automatically apply to the SCC chief operator. The important regulations when it comes to the duties of a shipmaster are in chapter I and VIII.

Regulation I/5 of the convention is titled as *National provisions*. It requires the parties to the convention to penalise acts that do not comply with the provisions of the national legislation giving effect to the convention. Reg I/5 3 is particularly interesting in this regard:

> ”4 In particular, such penalties or disciplinary measures shall be prescribed and enforced in cases in which:
>
> > .1 a company or a master has engaged a person not holding a certificate as required by the Convention;

[118] IMO, International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.
[119] *Ibid*.

.2 a master has allowed any function or service in any capacity required by these regulations to be performed by a person holding an appropriate certificate, to be performed by a person not holding the required certificate, a valid dispensation or having the documentary proof required by regulation I/10, paragraph 5; or

.3 a person has obtained by fraud or forged documents an engagement to perform any function or serve in any capacity required by these regulations to be performed or filled by a person holding a certificate or dispensation."[120]

The regulation then creates an obligation for the master to only engage persons that have the proper certification defined in the convention. This regulation concerns itself with operative matters rather than those that arise from being physically on a vessel, thus their application to the SCC chief operator doesn't at first seem to cause an issue. An interesting question however emerges from what the regulation refers to, that is the certifications. What is required from a SCC operator might not be what is required from a rating of a vessel. The SCC would have to comprise of operators certified for working physically on a vessel, which would require the operators to have many skills and attributes that are likely not needed in working in remote operations. For example the standards of medical fitness for ashore work should not be the same as of those working aboard a ship. Furthermore, the medical standards refer to the standards of medical fitness for *seafarers*[121], a category that does not include ashore workers. The convention would then require standards of medical fitness to be set for seafarers to be able to obtain a required certificate, but not to ashore workers. Yet the ashore workers at the SCC would need to fulfil these requirements to be able to operate the vessel remotely, because the SCC chief operator could not delegate navigational duties to an operator that doesn't hold the required certificate. The issue is somewhat done away with if one just accepts that the SCC operators need to have all the certificates that a seafarer is required to have as well, yet this solution seems lazy and inefficient in many regards.

Another interesting question in the convention emerges from regulation I/11 that deals with revalidation of certificates:

"1 Every master, officer and radio operator holding a certificate issued or recognized under any chapter of the Convention other than regulation V/3 or chapter VI, who is serving at sea or intends to return to sea after a period ashore, shall, in order to continue to qualify for seagoing service, be required, at intervals not exceeding five years, to

1.1 meet the standards of medical fitness prescribed by regulation I/9; and

[120] STCW Reg I/5 4.
[121] STCW Reg I/9 1.

1.2 establish continued professional competence in accordance with section A-I/11 of the STCW Code."[122]

The SCC chief operator does not serve at sea. If the requirement is applied, the SCC chief operator would only need to acquire the certification once and never revalidate it. If the competences that are certified are not required to be upheld, what then is the point of the certification?

Further operational duties of a master are laid down in the part A chapter VIII of the STCW code, titled "Standards regarding watchkeeping". Section A-VIII/1 deals with rest periods, Section A-VIII/2 with watchkeeping arrangements and principles to be observed. Most of the regulations in these sections and operational and do not seem to pose much of an issue when applying them to the SCC chief operator. Watch is kept at the SCC during the voyage and watchkeeping in port needs only to be arranged by the master[123]. The master is in the position to make such arrangements remotely as he is in command of the vessel, even if he is not physically on the vessel. However an issue seems to emerge when the ship is carrying hazardous cargo:

> "The master of every ship carrying cargo that is hazardous, whether explosive, flammable, toxic, health-threatening or environment-polluting, shall ensure that safe watchkeeping arrangements are maintained. On ships carrying hazardous cargo in bulk, this will be achieved by the ready availability on board of a duly qualified officer or officers, and ratings where appropriate, even when the ship is safely moored or safely at anchor in port."[124]

The ship would then have to have on board a duly qualified seafarer while carrying hazardous cargo in bulk. If this cannot be achieved the chief operator would have to refuse to begin the voyage, as the vessels cargoworthiness would not be up to what is required here. This seems to entail that hazardous cargo carried in bulk could not be carried in an unmanned vessel. In other cases the rule however requires the master only to ensure that safe watchkeeping arrangements are maintained regarding the hazardous cargo not carried in bulk. It is possible to think that there might be a way of achieving this without having a person aboard the vessel. Cargoworthiness is discussed later in the next chapter with seaworthiness.

STCW convention and code discussed here are seem to be the most problematic international legal instruments if one is to apply the legal status of a shipmaster on the SCC

[122] STCW Reg I/11 1.
[123] STCW Section A-VIII/2 90.
[124] STCW Section A-VIII/2 105.

chief operator. The question on the one hand is the substance of the certification, as the SCC chief operator would not need to have the firefighting or first aid experience that a person serving on a ship needs to have. Furthermore, the SCC chief operator does not arguable need to be in as good a physical fitness as the person working on a vessel. It would also seem that the master would never have revalidate his certifications after getting them because that is only required of seafarers. The principal problem on the system side however seems to be that the fact that the master and the crew are on the vessel is presumed. The underlying assumption that the people operating the vessel are seafarers, physically on the vessel and exposed to the somewhat uniform hardships of the sea. And the language of the instrument reflects this assumption at every turn. In my opinion the STCW convention and code constitute the greatest regulatory barrier to applying the legal status of a shipmaster on to the SCC chief operator.

Looking back at the initial question of what makes a shipmaster. As stated earlier, the shipmaster is a certified seafarer in command of the vessel. It would seem that the most interesting issue when it comes to the SCC chief operator is that he would not be getting the certification by only working on an SCC, but if he would be able to work as a master on a conventional ship, he would be able to work as the master on an SCC as well. With the wording as they are in STCW right now, he would then not be required to revalidate his certifications for working as a master, which makes it seem like the requirements of the instrument are easier for the SCC chief operator than what they are for the conventional shipmaster. And by employing only conventional shipmasters to work as SCC chief operators the requirement of being certified would be fulfilled. Thus from the angle of the certifications the SCC chief operator would fulfil the requirement of being understood as the shipmaster.

4.4 ISM and ISPS Codes

The International Safety Management code was created to provide an international standard for the safe management and operation of ships and for pollution prevention. The code is a result of the mounting concern about poor management standards in shipping in the late 1980s. The Code establishes safety-management objectives and requires a safety management system (SMS) to be established by "the Company", which is defined as the owner or any other organization or person, such as the manager or bareboat charterer, who has assumed responsibility for operating the ship and who, on assuming such responsibility, has agreed to take over all duties and responsibility imposed by the Code.[125]The code is made mandatory by SOLAS Chapter IX.

The rules for the masters responsibility and authority can be found in Part A 5:

> ”5.1 The company should clearly define and document the master’s responsibility with regard to:
>
> .1 implementing the safety and environmental-protection policy of the company;
>
> .2 motivating the crew in the observation of that policy;
>
> .3 issuing appropriate orders and instructions in a clear and simple manner;
>
> .4 verifying that specified requirements are observed; and
>
> .5 periodically reviewing the safety management system and reporting its deficiencies to the shore-based management.
>
> 5.2 the company should ensure that the safety management system operating on board the ship contains a clear statement emphasizing the master’s authority. the company should establish in the safety management system that the master has the overriding authority and the responsibility to make decisions with respect to safety and pollution prevention and to request the company’s assistance as may be necessary.”[126]

The master then has the responsibility to follow the safety and environmental tasks set upon him by the company, as well as the authority to make decisions and request the company’s assistance with respect to these responsibilities. Because the rules are formulated in a goal based way, defining the responsibilities of a shipmaster to fit the new setting shouldn’t create a regulatory problem.

The International Ship and Port Facility (ISPS) code forms the basis for a comprehensive mandatory security regime for international shipping, and it was made mandatory under SOLAS chapter XI-2. The code is divided into two sections similar to the STCW code, part A being mandatory while part B is left serving as recommendatory guidelines. Part A outlines detailed maritime and port security-related requirements which SOLAS contracting governments, port authorities and shipping companies must adhere to, in order to be in compliance with the code. In order to achieve the above objectives, SOLAS contracting governments, port authorities and shipping companies are required, under the ISPS Code, to designate appropriate security officers and personnel, on each ship, port facility and shipping company. These security officers, designated Port Facility Security Officers (PFSOs), Ship Security Officers (SSOs) and Company Security Officers (CSOs), are

[125] IMO, ISM Code and Guidelines on Implementation of the ISM Code (IMO.org).
[126] ISM Code part A 5.

charged with the duties of assessing, as well as preparing and implementing effective security plans that are able to manage any potential security threat. IMO is able to provide support to Member states in need of assistance in implementing the Code, by way of national and regional workshops, seminars, needs assessment missions, etc.[127] The code lays out a series of duties for the shipmaster.

The definitions show that the SSO is not necessarily the master of the vessel, thus the rules referring to the SSO cannot be claimed to be directly applicable to the SCC chief operator either:

> ""SSO" means the Ship Security Officer on board the ship, accountable to the master, designated by the Company as responsible for the security of the ship, including implementation and maintenance of the SSP and for liaison with the CSO and PFSOs".[128]

However, duties specifically for the master are found, as the duty for safety and security is established for the master in part A 6.1 the Code:

> "The company shall ensure that the ship security plan contains a clear statement emphasizing the master's authority. The company shall establish in the ship security plan that the master has the overriding authority and responsibility to make decisions with respect to the safety and security of the ship and to request the assistance of the Company or of Contracting Government as may be necessary"[129]

In SOLAS chapter XI-2 regulation 8 that concerns the ISPS code, the power to fulfil this duty of safety and security is granted to the master:

> "1 The Master shall not be constrained by the Company, the charterer or any other person from taking or executing any decision which, in the professional judgement of the master, is necessary to maintain the safety and security of the ship. This includes denial of access to persons (except those identified as duly authorised by a Contracting Government) or their effects and refusal to load cargo, including containers or other closed cargo transport units.
>
> 2 If, in the professional judgement of the master, a conflict between any safety and security requirements applicable to the ship arises during its operations, the master shall give effect to those requirements necessary to maintain the safety of the ship. In such cases, the master may implement temporary security measures and shall forthwith inform the Administration and, if appropriate, the Contracting Government in whose port the ship is operating or intends to enter. Any such temporary security measures under this regulation shall, to the highest possible degree, be commensurate with the prevailing security level. When such cases are identified, the Administration shall ensure that such conflicts are resolved and that the possibility of recurrence is minimised. "[130]

[127] IMO, SOLAS XI-2 and the ISPS Code (IMO.org)
[128] ISPS Code Part A 2.1.6.
[129] ISPS Code Part A 6.1.
[130] SOLAS Chapter XI-2, Reg. 8.

These rules in the ISPS and ISM code relate to the concept of *seaworthiness*, which includes *cargoworthiness* as well. Seaworthiness means in layman's vernacular that the ship is in a condition in which it can withstand the perils of the marine voyage in a proper fashion. The definition of seaworthiness was provided in a 1905 case *McFadden v Blue Star Line:*

> "A vessel must have that degree of fitness which an ordinary careful and prudent owner would require his vessel to have at the commencement of her voyage having regard to all the probable circumstances of it… Would a prudent owner have required that it (i.e. the defect) should be made good before sending his ship to sea, had he known of it? If he would, the ship was not seaworthy."[131]

While the duty of seaworthiness rests with the owner before the voyage, it is laid on the master during it. The Hague/Hague-Visby Rules provide that the carrier shall be bound before and at the beginning of the voyage to exercise due diligence to make the ship seaworthy; properly man, equip and supply the ship; and make the holds and refrigerated spaces in which cargo is carried fit and safe for its reception, carriage and preservation.[132] The standard is that the vessel must have that degree of fitness which an ordinary and careful owner would require his vessel to have at the commencement of her voyage, having regard to all the probable circumstances of it.[133] In the ISM Code and the ISPS security regime now in effect, the master is substantially involved in maintaining the vessel in a seaworthy state. Hence, vessels found to be operating without a safety management system[134] and a copy of the company's Document of Compliance[135] may incur civil penalties against the vessels owner, charterer, managing operator, agent, master or "any other individual in charge of the vessel.[136]

According to the book by Cartner, Fiske and Leiter, unseaworthiness is also used to characterize a situation where a vessel may be able to carry one cargo safely but not another, depending on the characteristics of goods to be carried. This is often referred to as

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[131] McFadden v Blue Star Line, [(1905) 1 KB 697].
[132] Cartner – Fiske – Leiter 2009, p. 180; Hague/Visby Rules, Art. 3 (1).
[133] Mandraka-Sheppard 2009, p. 325.
[134] ISM Code 2018, Part A 1.1.4: "*Safety management system means a structured and documented system enabling company personnel to implement effectively the company safety and environmental protection policy".*
[135] Solas Chapter IX, reg. 4: "*A document of compliance shall be issued to every company which complies with the requirements of the International Safety Management Code. This document shall be issued by the Administration, by an organization recognized by the Administration, or at the request of the Administration by another Contracting Government".*
[136] Cartner – Fiske – Leiter 2009, p. 181; *See* Antonio J. Rodriguez & Mary Campbell Hubbard, *The International Safety Management (ISM) Code: A New Level of Uniformity,* 73 Tul. L. Rev. 1585 (1999).

cargoworthiness. Examples of cargo-unworthiness are: defective cargo gears[137], leaky hatch covers[138], a defective bullion room in which to store a cargo of gold sovereigns[139]. The master always has the final responsibility for the sea- and cargo-worthiness.[140]

The rules in these codes boil down to the duty of safety and security of the ship and its contents, be it cargo or people. Seaworthiness and cargoworthiness are also embedded to the concept of safety. The master is given wide authority and independence in carrying out this principal duty, and in theory he cannot be penalized for going against the owners wishes when making a decision to fulfil his duty. Safety and security are open ended in these regulations, which is understandable for the multitude of different hazardous situations possible. However, this causes the regulation to be written in a "goal-based" way which in turn makes applying the rules to the SCC chief operator an easier task. The rules in most places do not refer to the location of the operating, rather that the master has a duty for safety and security. There is no regulation that bars the fulfilling of these duties from a remote location. The relevant question for the application of these rules is then a practical one: what are the systems that enable the master to fulfil this duty in a manner that's acceptable.

4.5 Conclusions

The international legal instruments affecting the master shown above reflect a variety of elements that seem to have been deemed important to protect and harmonise in an international level. These are salvage in general, certifications for seafarers, watchkeeping arrangements, the safety and security of the vessel and the environment, and seaworthiness and cargoworthiness. The conventions and codes have overlapping themes and connections all emphasising these elements. The analysis shows that there doesn't seem to be many regulatory barriers or problem points in international legislative instruments if the legal status of a shipmaster is applied to the SCC chief operator. Safety of the vessel and the environment is of the utmost importance for a conventional shipmaster as it should be to the SCC chief operator as well. The duty to engage in salvage is operational rather than locational, as it makes no difference

[137] Hang Fung v. Mullion [1966] 1 Lloyd's Rep 511, cited in BAUGHEN, SHIPPING LAW, 91.
[138] The Gundulic [1981] 2 Lloyd's Rep 418. cited in BAUGHEN, SHIPPING LAW, 91.
[139] Queensland National Bank v. Peninsular and Oriental SN Co [1898] 1 QB 567, CA, cited in BAUGHEN, SHIPPING LAW, 91.
[140] Cartner – Fiske – Leiter 2009, p. 185.

whether the operator is physically on the vessel or not. The capabilities of the vessel for salvage is another matter entirely.

The SCC chief operator would possess the knowledge of the ships characteristics and be the best person judge whether the vessel is seaworthy or cargoworthy, and to do this he could very well arrange for local inspections for this at port. As long as he is able to get the proper information without being present on the vessel, it doesnt seem to make a difference whether he is aboard the vessel himself or not. When it comes to hazardous bulk cargo however, the rule specifically states that a person has to be aboard the vessel to monitor the safety of the cargo. This person however doesnt have to be the shipmaster.

The principal regulatory problem however seems to emerge from the system of certifications in international regulatory instruments. The STCW is clearly created from the standpoint that the master is physically on the vessel. It also refers to the ships operators as seafarers, a status that does not seem to fit the SCC crew. The certifications also require experience of using systems on conventional vessels, systems that might not be used in the SCC. A proper fitness is required from the master, something that might not be reasonable to require from the SCC chief operator who never steps foot on an oceangoing transport. However as the STCW is formulated at this moment, the SCC chief operator would only need to acquire the required certifications once and never revalidate them again unless he wishes to work as a master of a conventional vessel.

The ISM and ISPS codes boil down to giving the shipmaster a duty for safety and security of the vessel from all quarters, and the necessary rights to fulfilling this duty. It would seem that there is no regulatory barrier for applying these duties to the SCC chief operator, rather the issue is with the company to make sure that the structure of the system enables the SCC chief operator to fulfil his duties.

As most of the shipmasters duties in international legislative instruments (save the STCW) do not seem to cause a great regulatory problem for the shipmaster, mainly because they tend to focus on operation of the vessel with open ended terms, the next thing to do is to evaluate the situation in national legislation. For this analysis I have taken as the basis the Finnish Maritime Code (FMC), a code that closely resembles other

Scandinavian maritime codes. The Especially interesting chapter for the analysis is chapter 6 of the FMC that deals with the duties of a shipmaster. While there are some explicit and implicit duties for the master in other parts of the Finnish Maritime Code, I have chosen only to focus on the chapter 6, as it is the most essential one where the shipmaster is regulated.

5 The SCC chief operator in the Finnish Maritime Code

The rules in the FMC that relate to the shipmaster are more specific than the international legal regulations. This is understandable, because the international rules need to be open and flexible enough to accommodate for a variety of different ways of implementation in different legal systems. In many cases the requirements of the international legal instruments have been adopted with a very similar wording into the national legislation, as is the case for example with section 3 a.1 § of the FMC titled "voyage planning[141]":

> "Prior to the beginning of the voyage the shipmaster has to ensure that the intended route has been planned using the appropriate charts and nautical publications of the area in question".[142]

Chapter 6 of the FMC contains the rules regulating the shipmaster. The FMC has duties for the shipmaster in other paragraphs as well, but these usually refer to specific situations such as the safety of the environment when operating a tanker. For this research I have chosen the parts of the chapter 6 that seem to be the most important if the SCC chief operator is to be undestood as the shipmaster in Finnish legislation.

The first discussed paragraph is FMC 6.1 §, which deals with the nationality of the shipmaster:

> "Only a citizen belonging to a member state of the European Union or the European Economic Area can act as the shipmaster of a Finnish commercial vessel."[143]

[141] Translations of the paragraphs of FMC used in this thesis are by the author.
[142] FMC 3 a.1 §: "*Päällikön on ennen matkan aloittamista varmistettava, että kuljettavaksi aiottu reitti on suunniteltu käyttämällä kyseessä olevan alueen asianmukaisia merikarttoja ja merenkulkujulkaisuja*", see STCW Code, A-VIII/2 5: "*Prior to each voyage, the master of every ship shall ensure that the intended route from the port of departure to the first port of call is planned using adequate and appropriate charts and other nautical publications necessary for the intended voyage, containing accurate, complete and up-to-date information regarding those navigational limitations and hazards which are of a permanent or predictable nature and which are relevant to the safe navigation of the ship*".
[143] FMC 6.1 §: "*Suomalaisen kauppa-aluksen päällikkönä saa toimia vain Euroopan unionin jäsenvaltion tai Euroopan talousalueeseen kuuluvan valtion kansalainen".*

The virtue of R&A operations is that the controller can be anywhere in the world. This rule would require then that the chief operator of the SCC who is for example a citizen of Turkey could not operate a finnish vessel remotely, even if the SCC where the operation is conducted from would be located in Finland. This then causes a situation where a remotely operated vessels chief operator would be decided by nationality, even if the person would be totally qualified for operating it. This could in turn encourage the shipowners to choose a different registry to be able to use for example a Chinese SCC service instead of a European one.

Perhaps the most important rule towards the shipmaster is the one in paragraph 6.3 § titled ”the shipmasters' substitute. The prohibition of exiting”:

> ”When the vessel is not moored at the berth or an otherwise safe anchorage, the shipmaster must not exit the vessel, unless it is unavoidable. If danger is threatening, he must not be off the vessel”.[144]

One can clearly see the issue facing the SCC chief operator in this rule. If the legal status of the shipmaster is applied to the SCC chief operator, he would only be able to be in command of the vessel when the vessel is moored at the berth or an otherwise safe anchorage. The issue can perhaps be argued away if it is accepted that being away from the vessel is unavoidable if it is controlled remotely. This does not however change the fact that if danger is threatening the vessel, the SCC chief operator would have to be on the vessel. However, the situation might not result in an impasse. The prohibition to exit the vessel is only penalized in paragraph 20:8 § of the FMC:

> ”If the shipmaster leaves his post and abandons the vessel entrusted to him, he must be sentenced to a fine or inprisonment for up to two years.
>
> If the shipmaster leaves the vessel, when it is in danger, without complying with what is stated in paragraph 12 § of chapter 6, or what is otherwise his duty as a good seaman, he must be sentenced to a fine or imprisonment for up to one year.”[145]

It would then seem that the penalization come from leaving his post and abandoning his vessel in the first place, something that is not connected to being physically on the vessel when it comes to R&A operations. The penalizations doesn't seem to be problematic in

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[144] FMC 6.6.3 §: ” *Milloin alus ei ole kiinnitettynä satamassa tai muutoin turvallisessa ankkuripaikassa, päällikkö ei saa poistua aluksesta, ellei se ole välttämätöntä. Jos vaara uhkaa, hän ei saa olla poissa aluksesta”.*
[145] FMC 20:8 §: ”*Jos päällikkö jättää toimensa ja hylkää hänelle uskotun aluksen, on hänet tuomittava sakkoon tai vankeuteen enintään kahdeksi vuodeksi. Jos päällikkö jättää aluksen, milloin se on vaarassa, noudattamatta, mitä 6 luvun 12 §:ssä säädetään tai mitä muutoin hyvänä merimiehenä on hänen velvollisuutenaan, on hänet tuomittava sakkoon tai vankeuteen enintään yhdeksi vuodeksi*”.

itself if it is applied to the SCC chief operator, as it seems to relate to the action of abandoning the vessel instead of not being on the vessel physically. The vessel is not abandoned if the person is in command of it and able to exercise control over it. The second part of the penalization however deals with leaving the vessel physically when it is in danger, thus connecting it to the duty in paragraph 6:6 § when danger threatens. The rule in paragraph 12 § of chapter 6 that is referred to in this rule relates to a distress situation where the shipmaster is allowed to leave the vessel if either his life is in grave danger or there is no reasonable hope for saving the vessel. None the less, it would seem that these rules amount to a situation where in the first place, the SCC chief operator is able to act as the shipmaster even when the vessel is not in port, as only the abandonment of the vessel is penalised. The duty in chapter 6 prohibits leaving the vessel, but not being on the vessel is not penalised, abandoning it is. However when the vessel gets into a situation where danger threatens, the SCC chief operator would instantly be breaking the rule by being physically away from the vessel, and thus he would end up being charged with the relevant punishment. Needless to say that this rule needs to be modified if one is to make room for R&A operations. However the source of the rule is not from international regulation, which makes modifying it a national matter, and thus a far easier task than modifying something required by international law.

Some other interesting elements are found in paragraph 6:12.3 § that deals with the situation where a vessel is in distress at sea:

> ”When salvage actions are initiated, the shipmaster has to lead the salvage operation, unless the local law or the salvage contract prohibits it. Everything saved, the amount of people taking part in the salvage operation and transporting the items to the storage place, and the work done must the shipmaster, personally or through a mate, make detailed notes. He is also responsible for reviewing and confirming with his signature the invoices for the costs of the salvage operation.”[146]

The SCC chief operator would then have to personally or by using a mate make the notes of this type of operation, as well as lead the operation himself. Furthermore he would have to personally sign the invoices for the costs of the operation without using a proxy.

[146] FMC 6:12.3 §: ”*Kun pelastustoimenpiteisiin ryhdytään, on päällikön johdettava pelastustyötä, jollei paikkakunnan laki sitä kiellä tai pelastussopimus sitä estä. Kaikesta, mikä pelastetaan, niin myös siitä henkilömäärästä, joka ottaa osaa pelastamiseen ja tavaran varastoimispaikkaan kuljettamiseen, sekä siinä suoritetusta työstä on päällikön, itse tai perämiehen avulla, tehtävä tarkat merkinnät. Hän on myös velvollinen tarkastamaan ja nimikirjoituksellaan vahvistamaan laskut pelastustyön kustannuksista*”.

These rules create an issue because they assume that the shipmaster is on the vessel. The SCC chief operator based in an ashore location would perhaps be able to lead the salvage operation, but this might cause issues if the person is on the other side of the world and poorly connected to the personnel physically in the vicinity of the vessel. Leading the operation could perhaps be understood as delegating the leadership to a local person in charge of the operation. This however seems to cause a situation where the SCC chief operator would be the leader of the operation only in name, yet still responsible for it.

Another question relates to the fact that the shipmaster or a mate has to make the notes of the afore mentioned details of the operation. Because the SCC chief operator is not physically in the location of the operation, it might be hard for him to get the proper information of the details needed for this type of note. An acceptable way of fulfilling this requirement would perhaps be to summarily accept the information that a local person is giving to the SCC chief operator, but without a clear rule this will undoubtedly cause situations where there are no proper information of the required things. The fact that the invoices need to be signed personally by the shipmaster also causes an issue when the shipmaster and the invoices are in different locations. The rules in this paragraph cause these regulatory problems primarily because the shipmaster has to personally execute the required tasks.

The last point of interest is the fact that the liability for damages of a shipmaster for a damage he has caused to someone whose interest he has to see to as an employee is to be judged by the rules of the liability for damages of an employee in the Finnish tort law.[147] As the SCC chief operator would seem to be more closer to a normal employee of the shipowner than a conventional shipmaster, this type of a rule seems peculiarly fitting for the new setting.

The Finnish maritime code is built on the presumption that a shipmaster is aboard the vessel which makes it doubtless that many other challenges will emerge if the status of a traditional shipmaster is applied to the SCC operator. However the most clear

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[147] FMC 6:17.3 §: ” *Vahingonkorvausta, jonka päällikkö on velvollinen suorittamaan, voidaan kohtuuden mukaan sovitella osoitetun syyllisyyden määrän, vahingon suuruuden tai muiden olosuhteiden perusteella. Työntekijän asemassa olevan päällikön vahingonkorvausvastuuseen sovelletaan kuitenkin vahingonkorvauslain säännöksiä työntekijän korvausvastuusta*”.

questions found in the rules of chapter 6 of the FMC have been listed, while most of the others seem to be fulfillable in the new setting. This is not to say that the requirements in the FMC would be the most reasonable way of executing the needed tasks, but rather that they do not seem to cause a regulatory barrier for making the SCC chief operator the shipmaster. Furthermore, the FMC does not state that the shipmaster has to be a seafarer, which makes applying the shipmasters' legal status to the SCC chief operator simpler.

6 Conclusions – The legal status of the shipmaster in R&A operations

The initial question was whether the chief operator of the shore control centre in R&A operations could be understood as the shipmaster, or rather if the legal status of a conventional shipmaster could be applied on the SCC chief operator. I started tackling the question from first trying to understand what a conventional shipmaster is. In this task I presented that the shipmaster is commonly understood to be a certified seafarer in command of the vessel. There were then three parts to the requirement to be researched. What is it to be a seafarer? And what is it to be in command? What is it to be certiefied?

First I discussed the status of the seafarer through the language of the definitions used by ILO, as well as through the factual concepts behind the instruments. The regulations that relate to the status of a seafarer seem to be mainly concerned with the work-environment of the person being on the sea. It seems that the status of a seafarer has little to do with operating a vessel, but it is mostly concerned with being on the vessel physically. Thus it seems unlikely that the SCC chief operator (or the SCC crew for that matter) would be given the status of a seafarer. However, while the shipmaster is understood as a seafarer, this seems to only be because a conventional shipmaster has always been a seafarer. The word is then used only because it has been practical to use in legislation to define the subjects of the rule, not because the requirement of being a master would specifically require the master to be protected by the specific labour requlations. Furthermore, it would seem that not all nations define their shipmasters as being seafarers either, which shows that the requirement is not in the core of being a shipmaster.

After discussing the status of a seafarer I turned to the question of being in command. I defined two different levels of control as being ”direct-control” and ”command”, two levels which somewhat correspond to the levels of responsibility in the STCW, those being the managerial and operational levels. I discussed the different configurations of vessels, being unmanned or with periodically unmanned bridges, to define who is in control and who is in command during use of the different control states designed by Rolls-Royce for their system. I came to the conclusion that the SCC chief operator is always in command of the unmanned vessel as long as the direct-controllers have enough real-time knowledge of the vessel and the ability to exert control over it. Vessels with periodically unmanned bridges however have two configurations, one that is connected to a SCC and one that is not. Here the issue seems to be that the system should still somehow be supervised, unless we accept the fail-safe systems to be secure enough to allow the master of the vessel to lose knowledge of the navigational decisions. An issue however emerges when the workings of the ANS go unsupervised, it would seem that control as it seems to be understood is lost. This in turn causes a situation where the human is out of the decision-making-loop, which in turn causes a problems in the liability regime that is built on the assumption that there is always a human somewhere in the loop. Furthermore, liability could be avoided by voluntarily giving control to the ANS when a dangerous situation arises, as liability might be then summarily attributed to the ANS manufacturer.

For a vessel that is connected to a ROC, it would be possible to keep up a more limited method of supervision by having the FMM operator supervise a limited number of vessels at the same time through their positional and other relevant data. This would keep a human always on the lookout for signs of danger and thus the ”human out-of-the-loop” -issue could be avoided. This would however require standards for the ROC systems to be set and harmonized to ensure that an acceptable level of supervision is kept in every situation.

The question then turned to analysing the most relevant regulations in international legal instruments pertaining to the status of the shipmaster, to identify what would happen if one would apply the status of a shipmaster upon the SCC chief operator. It turned out that UNCLOS, SOLAS and the Salvage Convention all created more or less a goal-based rule for the shipmaster to assist anyone in distress at sea. Nothing is said on what this assistance consists of or how it should be carried out, only that the duty is there to do so. Further rules on these aspects are operational and do not seem to cause a problem to the SCC chief operator.

Analysing the STCW convention and its code part A however turned up more principal issues. The instruments are written from the presumption that the shipmaster is physically on the vessel. The word “seafarer” is used continuously, and the shipmaster is understood to be working on an oceangoing vessel. These wordings would then suggest that the SCC chief operator would need to be certified as a conventional shipmaster, but that the certification would never need to be revalidated, because revalidation is only required of a shipmaster for working on an oceangoing vessel. He would also get into liability situations if he were ever to give a navigational task to someone who is not properly certified for it on an oceangoing vessel, despite the fact that the operation is conducted from ashore. The certifications also have requirements that are there only to ward off the hazards of the marine environment, such as the requirement of proper fitness, first aid skills and firefighting expertise. These are all requirements that do not have a factual, practical justification for an ashore worker. On the other side of the coin are understandably the qualifications that are not required, but that would be needed in the work on the SCC, such as possible IT certifications of the relevant training for using the technical instruments. This lack is however obvious for the reason that regulation is lagging behind the technical capabilities that seem to move at a tremendous speed.

Technically the requirements for the SCC chief operator to be understood as the shipmaster all seem to be there. The person may very well be qualified for working as a master, he might not be considered a seafarer, but being a seafarer doesn’t seem to be in the core of the concept of a shipmaster anyway, rather it has only been a conventional way of referring to a person working as an operator of a ship specifically. Despite working from ashore, the SCC chief operator seems to be in command of the vessel during all the legs of the voyage, no matter the control state. For ships with periodically unmanned bridges the questions are different all together, as one of the people aboard is likely going to be the master. The case for applying the legal status of a shipmaster on the SCC chief operator seems valid in the first instance.

What does the status of the SCC chief operator look like then if one is to apply the legal status of the shipmaster on him? On the international side of things the duties and rights of the shipmaster would likely stay the same. He would have to provide assistance in distress situations, work normally in salvage situations and be able to bind the owner to a salvage agreement. He would be in charge of the vessels' safety from all quarters, be it by making sure that seaworthiness and cargoworthiness of the vessel is up to par, as well as making sure that the security of the vessel is not compromised. He does not have to do any of these tasks personally right now either, rather he uses proxies that take care of the tasks for him. He is then able to trust that the information he gets from his workers, such as that the cargo is secured, is valid. This is the way he fulfils his duties, and the fact that he moves to another location does not reasonably cause a barrier for him to do so.

On the side of the shipmaster in his role as the agent of the shipowner, cargo-owner and the charterer, his tasks will likely diminish into a more navigational overseer. His rights and duties stemming from this agency relationship would likely lose meaning in many situations, but having the duties in the system does not seem to create a regulatory problem in my opinion. They may be activated if the situation so demands, but because the location of the master changes to a remote one, he is likely in no better position to represent the shipowner in a faraway location than the shipowner himself.

The SCC chief operator would then seem to be a person who is qualified for working as a master of a vessel, yet likely never using many of the skills required of him. His tasks would mainly concern navigational tasks, as well as tasks that are related to salvage. He would plan the voyage and take care of its other aspects, while always making sure that the vessel is sea- and cargoworthy. It would then seem that while the agency-related duties of a shipmaster might lose their meaning in many cases, the duties crafted in international legal instruments do not, and as such the SCC chief operators' status does not seem all that different from the legal status of a conventional shipmaster.

On the side of the Finnish Maritime Code, the basic issues found concerned the nationality of the SCC chief operator, salvage situations and the fact that the shipmaster must not leave the vessel. If the vessel flies the flag of Finland, the SCC chief operator must be of the nationality of a country belonging to the EU or EEC. This can in turn cause situations of discrimination, as a person otherwise qualified might not be able to remotely operate one vessel but be able to operate another, only on the merit that the vessels belong to different registries. The SCC chief operator would need to lead the salvage operation, personally or through a mate take detailed notes of what is salvaged and how many people help in the operation, as well as where the cargo is carried to for storage. He would also need to personally sign the invoices of the operation. This amounts to an issue because the SCC chief operator is not there personally to take these notes or sign these invoices. He is not the best one on the scene to get the information of the details of the operation either. Would he then be needed to fly there on the scene personally? Or would another person transferred to the scene be given the command of the vessel for the duration of the salvage operation to be able to carry out the duties of a shipmaster?

The principal question when it comes to the duties of a shipmaster in the FMC is the fact that the shipmaster must not be away from the vessel if danger is threatening. This would entail a situation where the SCC chief operator gets automatically in criminal liability for not being on the vessel when a dangerous situation occurs, barring *force majeure*. This in turn bars completely the application of unmanned remote operations, as the one in command would be automatically criminally liable if a dangerous situation arises. This requirement is however not based in international regulation, and thus it is a degree easier to amend as it stems from national legislation.

The difficult situations for R&A operations on the whole are not in the routine -type situations of shipping. The difficulties seem to emerge in unexpected situations and during salvage, which in turn links these difficulties to the requirement of good seamanship and salvage capabilities. However, the great majority of navigational tasks are routine navigation, which would mean that R&A operations are relatively difficulty-free for most of the time. If only 10% of the voyage is something not-routine, R&A operations have difficulties only during these 10% of the time. This is to say that everything need not be solved at once as one big bulk, rather that the systems seem ready to be utilized on some parts of the industry, and solving the other problems will make them ready to be utilized on the others. The baby doesn’t have to be thrown away with the bathwater.

7 The road ahead

The development in automatization and autonomy in the shipping industry ploughs on with new opportunities and developments every day. Research and development is being done in technology, regulation, business and politics alike to stay on top of the wave.

Solving problems and creating solutions always cause more problems that need solving, and it seems impossible to properly predict where everything is headed. With this research I hope that I have managed to give an insight into the ways that are helpful in formulation and understanding the legal status of the chief operator of a Shore Control Centre. The task for drafting new legislation in the international sphere for R&A operations seems monumental, and to be able to only modify the old system saves a great deal of time, effort and political capital globally.

The next big thing at the time of writing seems to be not about taking the manning completely out of the vessel, but enabling the use of the ANS on manned vessels to lessen the current manning and make the system of shipping more cost efficient and reliable for the companies without changing the regulatory system all that much. Remote operations seem to take longer, as does completely taking the crew away from merchant vessels to enable unmanned operating. The regulatory changes needed for the developments in the field on the international side will be up to the IMO as the quasi-regulative organization for international maritime law. Their work is part technical and part political, as the interests of the worlds' nations are tangled in the discourse for regulatory changes accommodating R&A operations. National regulation is however the key element in how the system develops, as the practical side of the matter is conducted through the different national laws. The development of the field, being part political, technical and legal, will no doubt go forward at a glacial speed and in somewhat unexpected directions, but will go forwards none the less.

A factor affecting development into a direction that better accommodates emerging technologies on the legal side, aside from political ones, seems to be the evolution of specific legal rules into more open, goal based ones. The goal-based approach gives room for different solutions and thus innovation, making it easier to experiment and develop R&A operations as well. This shift however requires a change in the mode of thinking from the private actors in the industry. As national legislation used to give clear parameters that the private actors needed to fulfil, it now gives room for innovation and different types of solutions by making standards more goal-oriented. Through this the mode of thinking of the private actors needs to change from reactive to proactive. Instead of doing explicitly what the government tells them to do, they are pushed into crafting their own solutions that fulfil the goals that the government sets for them. This in turn seems to have caused pushback from the actors in the industry. Rigid mindsets push back the change advocating for open mindsets, a change that hinders innovation overall and that has no other solution but time to get adjusted to.[148] I however acknowledge that change is not a virtue in itself, and that conservative modes of regulation help with upkeeping the stability and predictability of the system, especially in such a highly international and multicultural industry with countless of actors.

Changing of minds aside, it is understandably hard to make predictions about how law is changing in an industry on the verge of something resembling a revolutions. In a highly traditional and international field such as marine industries the gamechangers are technological development, national and international politics and economics. One needs to keep his eyes and ears open on the development in the field and in the tables that make the decisions to see where the future is headed. There are as many interests on the table as there are nations in the world, and it seems that the relatively wealthy nations are generally more pro-technological development. Shifting to R&A operations to decrease manning does not seem interesting for countries that have a massive pool of seafarers to send out to the seas, for example. Highly developed technological solutions can also be quite expensive, which makes them possibly attractive only to a limited audience in specific areas of the world. However, if the metric to measure whether R&A operations are "good" for the world are safety for property, human lives and the environment, as well as the long term economical gains through more efficient sailing, I would argue that R&A operations could very well be seen as a "better" way of conducting shipping.

After having discussed the issues relating to R&A operations, it seems that in the future we shall see a further move to more goal-based regulation and attempts of revision of the conventional regulatory instruments in the international sphere as well as on the domestic side. As the industry develops, societies should be prepared for the shift in both the demand of conventional seafarers as well as the composition of the skillset required of the seafarer in the future. The conventional seafarer will likely never disappear from the oceans, but the number of seafarers on ships will likely decline by time as new vessels are built with modern systems and existing ones are retrofitted with new technologies, if they prove successful. The balance of actors in the marine industry will likely change as well when new companies offering SCC services come into the picture

148 Aleksi Uttula, 19.2.2019.

to replace the conventional crew. Where the shipping company would conventionally hire single seafarers to make up the crew, in the future the shipping company would by the SCC service from a whole another company altogether. It would be beneficial for governance to make regulation that leaves room for innovation and adoption of new technologies to secure economic benefits, but to do this without compromising the goals that the regulative system aims to fulfil such as safety and security.

There is an argument that the safety of marine operations would be increased by the adoption of R&A operations by lessening manning and increasing the efficiency of the navigational instruments through self-optimising computer systems (the ANS). As it has been said that the cause of the greatest bulk of marine accidents is the human factor, the solution seems to be to make away with the human factor. But even while arguing that by turning to R&A operations we make away with many current issues, it doesn't remove the fact that new technologies always bring about issues not thought of. New unforeseen challenges will emerge, and even if the aspect of human error on safety of navigation is removed, the new challenges can create new types of dangerous situations. But without risk there is never any reward, and not taking any risks in the face of innovation will cause technological development to stagnate. Risks also need to be realized in practice to be able to learn from them so that they can be avoided in the future. What is needed is caution and carefulness, coupled with a great deal of fail-safe systems.