Re-boxing seamanship: From individual to systemic capabilities

1 Introduction

The concept of seamanship has been important in the maritime domain for centuries. It has been understood as a certain skilled practise, for example, the exercising of knowledge necessary to navigate, maintain and operate a vessel safety (Danton, 1996, p. xiii), but also more abstractly as 'a blend of professional knowledge, professional pride, and experience-based common sense' (Knudsen, 2009). When asking seafarers, good seamanship has been associated with the general ability to work safely and with ensuring high quality work (Antonsen, 2009). Individual capabilities include responsible and reliable work execution, and ensuring the safety of the crew, the ship and the cargo it carries.

In recent years, there have been considerable changes in seafarers' work environments. This includes the introduction of digital navigation aids such as ECDIS[1], autopilot systems and dynamic positioning systems for precise positioning in, for example, loading/unloading situations. The navigator has increasingly become a system manager when performing the work on the bridge. Regarding professional competence, specialisation and standardisation have gradually substituted practical experience as the main asset. In addition to technological innovations and professionalised competence management, safety management systems have been introduced as a requirement through IMO regulations, representing a framework for more detailed procedures and descriptions of lines of communication (Kongsvik, Størkersen, & Antonsen, 2014; Størkersen, Antonsen, & Kongsvik, 2017).

One question in relation to this is whether these considerable changes in work environments have influenced the notion and content of seamanship among seafarers, and if the integration of safety in the profession is changing. In general, a professional domain is not an objective entity, but may vary historically and culturally, and is thus constantly in motion and malleable (Fournier, 1999; Mclaughlin & Webster, 1998). For seafarers, the leeway for professional judgement seems to be shrinking related to both new technological aids and to the increasing proceduralisation of the work, a development that the maritime sector shares with other industries (Bieder & Bourrier, 2013). In this respect, references to aviation and the notion of airmanship and airlineship (Haavik et al., 2017) will occasionally be made to shed light on the development of seamanship as a case of a broader trend.

The aim of this paper is threefold. First, we wish to explore how seamanship is currently conceptualised in various discourses. Second, we will investigate how technological and administrative changes in the work environment have influenced the role of seamanship. Lastly, we wish to explore how changing conditions for seamanship and professional identity relates to maritime safety. While the relationship between seamanship and safety has been established in previous studies (see below), the changing nature of the work context and thus the changing nature of the seamanship-safety relation has to our knowledge not been systematically explored. This paper is a contribution towards understanding of these change processes.

[1] Electronic Chart Display and Information System

The rest of the paper is structured as follows: In the next section we present some earlier contributions from the literature on how seamanship is understood and conceptualised, and how the relationship between seamanship and safety has been explained. The methodological approach is explained in section 3. Thereafter, in section 4, we present the results from our empirical investigations of the same topics. One question is whether seamanship is on a path of 'erosion' or 'evolution', and this will be discussed in section 5. In this section, our findings related to seamanship, changing conditions and the implications for safety are scrutinized along five thematic transitions, resulting from our analysis: from individual seamanship to distributed maritime capabilities; from profession as ethos to profession as structured rationality; from tacit to explicit competence; from embodied to technified knowledge; and from individual to system. The conclusions from the study are presented in section 6.

2 Seamanship in the maritime industry

2.1 Conceptualizations of seamanship: Skills, sound judgements and work ethics

'Seamanship' has not only been a part of the everyday language of seafarers, but is a term also used in manuals, textbooks and in formalised laws and regulations[2]. According to Collins English Dictionary, good seamanship is 'skill in and knowledge of the work of navigating, maintaining, and operating a vessel'. This is in line with the classic literature, for example, the *Manual of Seamanship*, issued by the British admiralty in 1908 (Admiralty, 1908), which gives an introduction to sea terminology, a thorough description of how to make knots, handle anchor cables and buoys, descriptions of how different operations should be conducted, etc. The content of the manual ranges from descriptions of different equipment and tools, how different skills should be performed, how activities are organised and the responsibility and authority of onboard personnel.

"Good seamanship" is also used as a concept in international and national regulation of shipping. Still, there is a lack of attempts in these regulations to define what "good seamanship" actually denotes. This general use of the concept in regulations has been explained as a solution to the problem of trapping all required actions into rules. According to Gilmore and Black (1975) it would be impossible to describe all possible situations and choices of action that would be relevant for operating a ship and for which seafarers have a legal responsibility to perform. Good seamanship becomes a term embracing a range of issues, including those written down in the form of rules. Following Gilmore and Black (1975), seamanship in the legal context seems to mean the totality of tasks that seafarers are expected to conduct, including the ability to make proper judgements in order to handle changing and unforeseen situations. If we look at the usage of the term in Rule 8 of the International Regulations for Preventing Collision at Sea (IMO, 1972: 7), good seamanship' seems to describe a certain way of handling a certain situation: 'Any action to avoid collision shall be taken in accordance with the Rules of this Part and shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship'.

Sound judgements, and not only strict rule-following, still seem to be an important part of the conceptualization of seamanship. When used, for example, in a manual developed by the Canadian

[2] The term is, for example, used in Rule 8 in the International Regulations for Preventing Collision at Sea (COLREGS) and several guidelines issued by the International Maritime Organization (IMO), such as 'Guidelines for the Preparation of the Cargo Securing Manual (IMOMSC.1/Circ.1353)' and the 'Amendments to the Code of Safe Practice for Cargo Stowage and Securing (IMO MSC/Circ.1026)'.

Coast Guard, the term seems to foremost describe the ability to continuously evaluate the development of a situation, make appropriate judgments and conduct the adequate actions, as well as question rules (Canadian Coast Guard, 2011, p. 133):

> The rules are not there to replace good judgement and practice of good seamanship. You should not put your vessel in danger by blindly following the rules. You should consider all factors pertaining to navigation (water depth, wind, traffic, current, manoeuvrability of your vessel, etc.) when complying with the rules.

Such a description corresponds with the concept of *ship sense*—cognitive and perceptual capabilities involved in practising "the skills of ship manoeuvring and the underlying cues used by the ship handlers" (Prison, Dahlman & Lundh (2013, p. 117).

Good seamanship seems also to be used—at least among seafarers themselves—in order to signal expected work ethics; that is, a set of characteristics, attitudes, priorities and a way of behaving that are required from a proper seaman. A survey conducted among Norwegian seafarers showed that conditions related, for example, to sociability, loyalty and obligations to fellow seafarers, independency, responsibility, reliability and willingness to work were among the characteristics that were used to describe good seamanship (Antonsen, 2009). The inclusion of work ethics, sociability and loyalty into the concept of good seamanship may be understood as a consequence of distinctive characteristics of the ship as an organisation. The ship is a social system that, together with prisons, military organisations, monasteries, boarding schools, mental hospitals, etc., are characterised by conditions that coincide with Goffman's (1961) ideal description of 'total institutions'. Several researchers have addressed this resemblance (Aubert & Arner, 1959; Serck-Hansen, 1997; Lamvik, 2002; Knudsen, 2009; Wahl & Kongsvik, 2018) and focused on the restricted physical and social environment that the seafarers must cope with 24 hours a day for several weeks or months. Total institutions contribute, according to Goffman (1961), to certain behavioural and interactional patterns and may contribute to a strong alignment among the members in terms of behaviour and world views.

Characteristics of the traditional technology and the work organisation on board vessels may explain why seamanship also is associated with cooperation skills, trustworthiness (Antonsen, 2009) and "compatibility" with colleagues (Bye et al., 2015). A ship as a traditional autonomous, isolated and self-sufficient work community requires extensive cooperation and coordination in order to perform required tasks. Interdependencies, "tight coupling" and highly coordinated tasks characterize various types of work operations, e.g. as shown in connection with work on deck on anchor handlers (Vandeskog, 2016). With reference to e.g. Hutchins (1991; 1995), this may be considered to require a sort of distributed cognition among seafarers on board a vessel, i.e. that knowledge and cognition is distributed across objects, individuals, artefacts and tools in the environment.

The use of the comprehensive and rather vague concept of seamanship could also be seen as a reflection of how seafarers traditionally have been trained and educated (Bye et al., 2015, Bye & Aalberg 2020). Traditional training of seafarers from novices to experts has foremost been based on development of their competence through practise and oral transfer of knowledge. The formalised systems and requirements of seagoing service in order to obtain certificates exemplifies this orientation. The novice obtains skills and knowledge through trial and error in an attempt to adapt to the established practise. Within this context, the use of the term 'good seamanship' may serve to mediate to the novice whether actions are in accordance with the expectations of a proper seafarer. The mentors could then use good seamanship in order to denote that a certain task performance is according to the expected practise. Bye and Aalberg (2020) claim - with reference to Nonaka and

Takeuchi´s (1995) organisational learning model - that the learning process traditionally has been based on *socialisation* by imitating practises, and not by *internalisation* of written or oral descriptions of how the work should be performed. As such, seamanship is clearly grounded in communities, but primarily a reference to individual qualities reared in these communities.

The use of the term seamanship among seafarers has also been interpreted as a means of social categorisation and construction of identities by establishing a division between 'us', the 'proper' seafarers, and 'them', the others who 'lack good seamanship' (Serck-Hansen, 1997; Lamvik & Bye, 2004). The others who are considered not to possess 'good seamanship' may vary and could include seafarers from other nationalities (Serck-Hansen, 1997; Lamvik, 2002; Lamvik & Bye, 2004), seafarers working on coasters (Størkersen et al., 2011), or 'landlubbers' (Bye et al. 2015). When used in order to constitute identities, the concept may also describe more than the appreciated skills and "know how" of the individual, but may even include certain attitudes, values and worldviews (Serck-Hansen 1997, Lamvik 2002, Lamvik & Bye 2004). This implies that the concept of "seamanship" in some situations may include aspects that within the community of safety researchers have been addressed by using the concepts of "safety climate" or "safety culture" (e.g. Antonsen 2009).

Knudsen (2009) also addresses how seamanship function as a means to construct identity, by claiming that term may be used to express 'professional pride'. This understanding seems to be stem from the notions that the seafarers e.g. use the term in order to express an antipathy towards written rules and procedures. 'Good seamanship' becomes an ideal that is considered as contradicting with formalized rules and paperwork. This contrasting function of the term is also apparent in a study conducted by Størkersen et al. (2011) of seafarers on coastal cargo vessels when addressing the implication of the introduction of the ISM code within the industry. The authors showed, however, that written rules and paperwork are not necessarily included in the antipathetic term 'paperwork' but only include those papers and activities that a group of seafarers does not recognise as relevant for operating the vessel.

'Good seamanship' seems to be a normative positive word that traditionally has addressed characteristics and abilities that seafarers possess, gained through practise, evaluated and recognised by fellow seafarers. Seamanship is 'embedded', and it constitutes a proper seafarer within the community of proper seafarers. It is something that individuals have earned through practise, and not something that can be represented and learned by the use of documents or books. Within this context, formalised procedures could give a feeling of devaluation of the importance and appreciation of the competence of the individual seafarer.

That seamanship is embedded can also be read into the context of Hutchins (1995) and Latour (1992) and their elaboration of cognition as an embodied, material and socially distributed activity. This perspective opens up transcending the individual in search of seamanship, approaching it as a systemic phenomenon.

2.2 Seamanship, variability and safety

Much debate within the recent safety and reliability literature has been devoted to the balancing of rules and flexibility (Dekker, 2003; Hale and Borys, 2013). There is, arguably, a tendency toward increased proceduralisation in most organisations today (Bieder & Bourrier, 2013). Procedures govern work in a more detailed manner and, to an increasing degree, they are introduced into realms where professional discretion – such as seamanship – traditionally has had more leverage. The prescriptive standardisation of tasks is also an important coordinative measure. It is easier to coordinate large operations when tasks, technology and terminology are standardised. For example, standardisation is a basic condition for coordination in aviation (Haavik et al., 2017).

Modern organisational designs are increasingly based on principles of accountability. Related to safety, managers have to make reports and measurements to show that operations are safe, and consequently they are drawn towards an anticipatory and prescriptive way of thinking, the making of rules to make sure that what has happened before will not happen again. If it does happen again, it is a violation of procedure and managers are not to blame (Power, 2007; Wildavsky, 1987; Antonsen et al., 2008). Procedures and rules are regarded as sedimented knowledge of previous experience, decontextualised to reduce the risk of new accidents.

Simultaneously, there are several voices, most notably in the Resilience engineering strand of research (Hollnagel et al., 2006), arguing that safety cannot only be reduced to following rules. In the maritime context, contextual factors such as other maritime traffic, technical difficulties and weather conditions might align and create unforeseen situations for which the handling is not described in any procedures or rules (Wahl et al., 2020). According to Hollnagel (2009), performance variability involves adjustment of performance to meet changing conditions and might sometimes involve working outside procedures. This is in line with some of the conceptualisations of good seamanship described above, involving continuous evaluation of situations, making sound judgements and also questioning rules if appropriate. Some ship operations are still routine and controllable, and our cases will illustrate some differences between types of ships (supply vs anchor-handling vessel) in this respect.

3 Methods

The empirical work was completed on two offshore vessels operating in the Norwegian sector of the North Sea. One of them was a supply vessel transporting on a fixed route containers and bulk products from onshore supply bases to different petroleum installations. The second was an anchor-handling vessel involved in moving offshore oil drilling rigs. Unlike supply vessels, the operations on anchor-handling vessels are less standardised. Each rig move can have different characteristics depending on the state of the anchoring, the oil rig that is to be moved, weather, sea current conditions, etc. Both vessels were quite new, built less than 10 years ago. The crew on the supply vessel consisted of 12 persons, including bridge personnel (captain, 1st and 2nd officer), four able seafarers on deck and three persons in the engine room (chief engineer, engineer and electrician). In addition, there were two cadets on board, completing their obligatory practical training. In the anchor-handling vessel, there were 15 persons, including seven persons on deck, four officers, and four persons in the engine room.

We participated in two voyages, one on each of the vessels, both lasting two days. Four researchers (two on each vessel) observed the work that was performed on the bridge, on deck and in the engine room facilities and conducted several informal (not recorded) discussions covering all functions on the ship.

During the voyages, we interviewed 14 crew members (seven on each vessel), some individually, but with one group of two persons and one group of three. Individual and group interviews might have different dynamics (Crabtree et al., 1993). In group interviews, informants interact with each other in addition to the interviewer, providing opportunities for synergism and snowballing of the discussion. On the other hand, group interviews might represent a context where some informants dominate the interview and others become passive. Hence, a combination of individual and group interviews was considered a good compromise. Those interviewed varied in age from 22 to 62 years old.

The study was a part of a larger research project, where the aim was to explore what constituted professional competence in different modes of transport (aviation and maritime), and also the relation between professional competence and standardized rules/technology, and the resultant consequences for transport safety. As the literature review illustrates, 'seamanship' involves some special competencies and work ethics, and may also serve as a means to construct identity. At the same time, seamanship can be considered 'embedded', which implies that the subjective meaning of seamanship can be influenced by contextual developments in technology, safety management systems etc. This was the starting point for carving out the following main topics for the interviews (examples of questions in parenthesis):

1. Introduction and background of the informants (age, experience, education)
2. Seamanship (e.g. 'What do you associate with good seamanship? What kind of changes have you experienced in your profession in later years?')
3. The work (e.g. 'What are your work tasks? What kind of professional competence do you need in your work?')
4. Technology (e.g. 'What kind of technological aids do you use in your job? What do these mean for your competence as [position]?'
5. Safety management (e.g. 'What kind of procedures, check lists and rules do you use in your job? What do they mean for the job that you do? What is the role of professional judgement in your job?)

The interviews were semi-structured, and lasted from 30 to 90 minutes. They were audio recorded and 12 of them were transcribed verbatim. Due to bad recording surroundings/noise, the data material from two interviews consisted of notes.

Each part of the data material was thoroughly read through by each of the authors. The material was structurally coded (Saldaña, 2016) by the individual researcher, involving writing a 'conceptual phrase' (p. 98) related to the aim of the study, and three main topics derived from this aim; 1. Seamanship 2. Changes in the working environment and 3. Safety. The members of the research team then met several times for joint analysis, and compared and commonly reflected on the coding. The analysis can be considered thematic, as it revolved around some predefined themes of interest, and also abductive (Bryman, 2012), as it was carried out as an iterative process involving previous research and conceptualizations of seamanship and the empirical findings.

All members of the research group had previous experience with research in the maritime domain through PhD work, and a range of different research projects where topics directly or indirectly associated with seamanship have been explored. Findings and insights from this research also contributed to broadening our understanding of seamanship, although explicit empirical references are limited to the research project on which this article is based.

4 Results: Seamanship and changes in the maritime industry

4.1 The seafarer's notion of seamanship

In this paper, we ask if and how developments in the seafarer's work environment and contextual conditions influence the role of the 'classical skills' associated with the profession. When discussing this with our informants, they also conveyed their general notion of seamanship—regardless of the ongoing changes in the maritime industry. This served to set the scene and provide a context for the more specific elaborations of change processes that were consequently discussed.

Among those interviewed, there were examples of traditional notions of seamanship, involving practical skills and taking care of the ship, the cargo and each other. These were typically provided by seafarers with more than ten years of experience from the maritime domain. One of those interviewed associated good seamanship with taking care of oneself and each other.

> You should take care of yourself. […]. Good seamanship is that you can cooperate with everyone and have good teamwork. I define good seamanship as thinking about the one next to you in any situation. You think about taking care of them and that you have a responsibility towards them.

Others associated seamanship with the ability to solve problems through skill-based improvisation, so that missions could be completed as planned, and the ability to keep calm during such problem solving. One chief engineer shared an illustrative story related to an electrical fire that happened to one of his colleagues:

> Then they got a fire in several fuse boxes in the engine room. As they were far out at sea, they had no choice but to make their own fuses. They used copper cables right, and then they went off, and they had to experiment and use thicker ones, until they held. And then they came to shore with this bird's nest, and the electricians just stood there in awe.

In contrast, several of the younger members of the crews, typically with less than five years of experience from the industry, felt that seamanship was a somewhat outdated concept, and not of any particular relevance for the present work environment. The following is an illustrative example from a trainee:

> I don't know, it is not something that you talk about every day. It's not like that. It is a kind of old word. It's related to the old sailing ships, it comes from that period.

It is possible that this divide between young and old members of the crews can be an expression of young members not yet being fully socialised into their roles. When we analysed the data material in its entirety, an alternative and equally plausible explanation emerged—that the differences are related to quite rapid changes in crew work environments in general.

4.2 The seafarers' notion of changes within the maritime industry

Through an iterative review and categorization of our informants' reflections on the development of the professional identity of seafarers, our material suggested four dimensions that were particularly relevant to the nature and development of the perceptions of seamanship: (1) technology development; (2) proceduralisation; (3) training and education; and (4) generalised competence. We will present these dimensions and their significance for shaping the characteristics of seamanship, as the maritime domain is increasingly influenced by contemporary trends relating to increased efficiency, standardisation and technology development. Towards the end of this section, we seek to link professional identity and seamanship to safety before we continue discussing broader safety implications of the identified changes to the characteristics and values of seamanship.

4.2.1 Technology development

One broad development of relevance is the introduction of new technologies, in particular on the bridge, including navigation and positioning tools, but also in the engine through increasing automation and data gathering (some of which is mainly meant for onshore analysts). The introduction of autopilots in combination with digital maps is one of the new technologies applied. In addition, dynamic positioning systems (DPS) are highly relevant for the crews on the offshore service vessels. DPS, consisting of thruster propellers, GPS or other positioning instruments and a

computer, keeps the vessels in a fixed position during loading and unloading operations offshore and are also used to some extent in anchor handling operations.

The developments in technological aids were perceived to have changed the role of navigators from being constantly active in all phases of operations to more passive monitoring of the technology for longer periods. On supply vessels, this included high-risk operations, such as loading/unloading alongside offshore installations. One of the navigators on the supply vessel expressed that, in reality, you could train someone to do his job in no more than three months, and that virtually everyone could do his job. Further, he expressed that: 'To be honest, there is no one that could NOT perform my job. It is not possible that you could not learn this.'

Although formal education and training of navigators had involved learning the classical nautical skills, these were not regarded as necessary to do their current job.

Engineers expressed that the computerization and automation of systems in the engine room had made them feel less in control over what was going on. One of the senior and experienced engineers put it like this: 'So, the engine room has changed quite a lot, also in that there are things that we have no control over. Like the IT systems.'.

The perception of less control was both related to limited insight into how the IT systems worked and to restrictions related to what the crew could actually do when IT systems malfunctioned. In many cases, fixing of malfunctions required outside expertise from the supplier, and it would represent a breach of class requirements if the crew tried to do something on their own, even if they had the knowledge.

The automation was less evident on the anchor-handling vessel, especially for the officers on the bridge. The anchor handling operations involved high levels of energy and were described as high-risk activities, requiring strong involvement and coordinating efforts. One navigator said that:

> It is vital that the person on the bridge knows the hazards threatening the people on deck. […] It is quite impressive that those sitting in the captain's chair have control over everything. But they have been around a long time. They lean on that experience.

Important activities on the anchor handler thus seemed to be more knowledge based, and not very suitable for automation. For example, operating winches and decking of anchors require continuous adaptions to the position of the vessel, weather conditions, waves, currents etc.

4.2.2 Proceduralisation

Another change that was highlighted, especially among those that had more than ten years of navigator experience on the supply ship, was the rising workload related to procedures and checklists referred to, in short, as 'paperwork'. This involved all parts of the life and activities on board, including everyday duties and housekeeping, as illustrated below:

> One example is that the sailors should wash the toilets twice a week, and they should sign on a list that they have completed the task. Then the ship's cook should check that this has been done once a week. The safety officer should check this once a month. And the safety officer should also check that the cook has checked.

The ship owner had implemented a safety management system (SMS) as required in national regulations and in accordance with the International Safety Management (ISM) Code. For example, when the supply ships entered the 500-metre safety zone surrounding the offshore installations, a

40-item checklist was to be filled out and filed. There were also quite detailed procedures related to most of the operations.

The emphasis on safety management was partly explained as a result of requirements from the petroleum company that was contracting the ships. As a high-risk industry, the SMSs in the petroleum companies were highly developed over several decades and were also reflected in the requirements towards the ship-owners.

The navigators regarded this development as a marginalisation of their professional competence and skills. One said that: 'It is almost as you are not allowed to think for yourself anymore, everything is taken care of by procedures.'

Several of those interviewed saw this development as compromising safety, as they might not be prepared for unforeseen events not covered by procedures.

Maintenance of the engine and related systems was also programmed in quite a bit of detail according to the informants. Requirements and recommendations from the engine producer were implemented in a maintenance computer programme, giving the crew notifications when engine parts or subsystems should be attended and providing details of what should be done. Although this ensured that the crew got information on what and when necessary maintenance should be done, it also reduced the need for professional judgement and attention.

On the anchor-handling vessel, the proceduralisation was also commented upon in a similar fashion, but the informants distinguished between the planning and transport phases, on the one hand, and the anchor handling operations on the other. While they used checklists and other administrative tools during planning and transport, the anchor handling was described as a skilled craft not easily captured in standard procedures. Still, they had a general plan for how the operations should be completed, defined in a scope of work document. One navigator expressed that:

> We do not have many checklists during the operations itself, but the scope of work describes what is going to happen and in what order.

During anchor handling, constantly changing conditions required adaptions to how the work was done. It requires a dynamic balancing of forces between currents, waves and wind, weight pulled, and engines and winches, requiring the officers to lean on experience from such operations and also from the particular ship itself, the strength and the reliability of its engines and winches and the margins they operate within

4.2.3 Professional competence

4.2.3.1 Training and education

The informants' previous training and education varied. Several, both working on deck and on the bridge, had worked as fishermen, some of them from an early age, before they began their careers in the offshore maritime industry. The younger ones had, in general, a more formal background involving maritime high school and college education that combined periods of theoretical input onshore with practical training on board.

For navigators in particular, the training and education seemed to have become more theoretical, streamlined and standardised. The senior navigators referred to an earlier career path that involved much more practise, where you started out as an ordinary seafarer and were promoted based on experience and acquired practical knowledge. Although formal education was also necessary, it was more integrated in the practical learning of the profession.

> Yes, that career path was common before. You started out as a 15 years old boy at sea. You do not have that possibility now, hardly not.

Some of the navigators saw this as a negative development that limited the learning of basic skills and the understanding of the work that was performed outside the bridge or engine room. One chief engineer in his thirties working in the engine room, stated that:

> For my part, I am quite young, and I have received the highest certificate, so I can be chief engineer on the largest ship that has ever been build. That would be foolish and irresponsible. You should climb a bit, go the steps before you become chief on such a boat.

Based on the interview material, the increased emphasis on formal qualifications and the reduced weight put on practical experience was perceived as something that could threaten safety.

4.2.3.2 Generalised competence

Crew members on the supply ship claimed that the education related to the different positions on board had become more generalised and less specialised to the maritime work environment. According to the informants, this made it easier to change jobs and pursue a career onshore, in contrast to how it was before when working at sea was considered a career decision for life.

> I think that all the professions that are on board now could have gotten a job onshore. We have seen that those qualified as a first officer or captain have switched to the petroleum industry. If you are an engineer, you could just as well work at a hospital. And the stewards can always get a job somewhere.

As their competence had become relevant outside the maritime industry, and this had opened up alternative career paths, the identity as a seafarer might have been influenced.

Again, this differed for the crew on the anchor handler. One of the navigators expressed that:

> Regarding my education, it was not much I could make use of when I started here. When I started on deck, I just stood there, did not understand anything. It actually took three or four trips before I understood how things worked, and maybe a year before I felt comfortable and understood what was the next step, that I knew what was going on the whole time.

Thus, on the anchor handler, the competence needed was more specialised for many of the positions on board, and the work required substantial experience.

4.3 Seamanship and safety

In one of our observations on the anchor handler, we were chatting in the dirty mess[3], a resting room for the deck crew. They operated in teams of three, two able seafarers and a boatswain[4]. In operations they communicated with short commands and gestures, the team moving in a tight knit, almost choreographed[5] manner. The boatswain also communicates with the bridge with brief radio messages. It is craftsmanship and teamwork conducted in noisy, dangerous conditions in surroundings presenting great hazards. The forces from tense wires and heavy equipment can be deadly, the ship rocking in the waves and the foaming North Sea around the open stern of the ships looking unforgiving. When we asked them about procedures, the boatswain noted that on deck they had to make judgements themselves, in coordination with the bridge. There were few prescriptive

[3] This is where they rest and eat when they are in their overalls, ready to go on deck on short notice.
[4] Maritime for team leader.
[5] See Vandeskog (2016) for a description of the relational and dynamic aesthetics of the coordination among the team on deck on anchor handlers.

rules that told them exactly what to do, more general principles to follow as they tried to solve their tasks as safely as possible. But, he lamented, '…as soon as we are onshore and want to do a paint job or something, there are all sorts of procedures to follow and forms to fill out.'

This point is illustrative. The safe operations on deck could not be reduced to prescriptive rules. They unfolded dynamically, and sometimes unpredictably, in dialogue with the bridge and with contingencies presented by nature and the equipment, and they needed to adapt to the dynamics of the situation. In contrast, the work in harbour, clearly less dangerous, could be, and was, controlled more prescriptively. Anchor operations are particularly dependent on skilful work execution, both on deck and on the bridge, as powerful winches and engines need to be balanced against the heavy loads, winds and currents. Though these operations, too, are increasingly supported by automation, anchor handling has a high status as work that demands skilful seafarers. This is also reflected in the fact that the company required more years of experience for promotion to first officer on these ships than the official requirement in the industry.

Those with the long maritime service (approx. more than ten years) expressed that the working conditions had improved over the years, including shorter working periods and better possibilities for having a more normal family life. Several also expressed that safety had improved because of new technological aids and safety systems on board.

Still, concerns were raised about the narrowing of possibilities to use their professional judgement. Representatives for all positions on board both ship types expressed that the requirements for documentation and the use of checklists had increased to the extent that safety critical tasks such as navigation could suffer. Even if this could be compensated with more crew on the bridge that could handle the documentation tasks, the workload was still considerable for key personnel such as the captain.

It was also worrying for some that experience-based competence was receding, as this might reduce the ability to act on 'weak signals' for possible safety problems. To be able to identify possible hazards based on unfamiliar sounds, smell, vibrations, etc. was by some regarded as important, but something that 'the younger generation' was less able to do, according to those with long experience. A soon-to-be-retired chief engineer with more than 40 years of experience told a story about a time he had used his experience to resolve what turned out to be a major problem.

> It was a sound that I heard that should not have been there. I went by one of the engines and heard a clinking sound, even with my earcups on. So I went back and said I think an injector has broken and said that we must stop the engine. It was an experience-based intuition, because I am so familiar with the sound when all is working fine.

According to the chief engineer, it turned out that the damage to the engine was so serious that it could have exploded. He stated that those new did not have the same starting point for developing this kind of 'intuition'.

The same scepticism towards those with a more recent and standardised background was also voiced by others:

> I see the development that is happening now, and it scares me a bit. […] They come as theoreticians and think they know everything, but then they know nothing because they have not done anything practical. They cannot put things they have read while sitting in an auditorium half asleep into practise.

Seen from the perspective of the experienced seafarers, newcomers lack experience-based competence and accumulated 'intuition'. This might in turn reduce the ability to recognize anomalies and 'weak signals' in the daily operations. The deficiency is further linked to how seafarers are now trained, involving a more theoretical approach and less weight put on experience-based training. Also, proceduralisation reduced the possibilities to use their professional judgement. As a consequence, the ability to make sound judgements could be affected negatively in the longer term.

The reduced leverage for a dynamic situational professional discretion is partly caused by proceduralisation within shipping and petroleum generally. However, there are also technological changes in the normal operations making it less necessary. Previously, just the normal sailing of the ship from one port to the other required more attention by captains and crew, but this is now partly managed by autopilots and DP systems.

What we see is that the skilful dynamic balancing has moved to other situations. Their seamanship is executed *with* technology and *with* rules in more complex situations, also stretching beyond the ship; as *distributed maritime capabilities*. The management of a complex anchor handling operation involves many aspects of tacit embodied skills and coordinated actions both on deck and on the bridge, but it is also a skilful act of coordination with other ships and the rig, or managing a supply ship within the logistical operation of the petroleum company, requires other skills than those traditionally associated with seamanship.

Similarly, rules do not merely replace competence; they present, in the same manner as technology, new framework conditions within which their situational adaptation occurs. One example from the anchor operation can exemplify this. Corporate guidelines put environmental constraints on their sailing speed. Steaming full ahead produces more pollution. Our captain, when considering the schedule of the operation in total and the weather forecasts, had to make a judgement as to whether he should ask for permission to go beyond this speed when sailing to the site of the operation in order to reduce the risk of a delay in the operation and of having to conduct it in worse weather. This is situational adaptation in which rules and regulations are a part of what is being juggled.

5 Discussion

5.1 Transition from individual seamanship to distributed maritime capabilities

While experienced seafarers (more than ten years of experience) expressed concern that important individual characteristics and competence associated with good seamanship were weakened as a result of changes in the industry during the last decades, seafarers with less experience (< five years) tended to argue that the concept of seamanship and its subject matter had lost some its relevance. Based on the empirical findings, we suggest that these differences are related to changes in the work context.

Among our informants, there is a distinct discourse about the changing role of seafarers, and that these changes are taking place in a context characterised by technological development, proceduralisation, training schemes and competence characteristics. As a consequence, the traditional (emic) notion of seamanship is challenged.

In Figure 1 below, we suggest that these development trends may push the content of seamanship further in a systemic direction where the attention on competences, attitudes and practises of the

seafarers is supplemented with an increased attention to the whole sociotechnical system, exceeding the hull of the single vessel.

We coin the term 'distributed maritime capabilites' to denote this development. The capability concept is often used at the system level, embracing resources, capacities and abilities affecting an outcome (Lindbom et al., 2015). For example, Bhatta (2003:403) defined capabilities as the resources, systems, structures, and processes necessary to deliver – currently and in the future – the required level of performance in fulfilment of the mandated objectives.

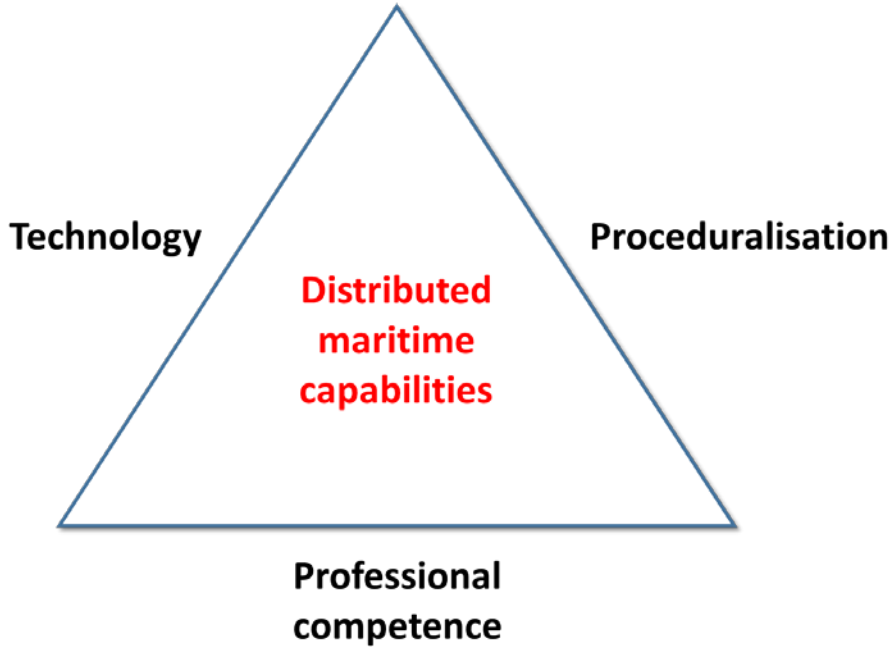

Figure 1. Contextual developments with possible influence on the professional identity as a seafarer

There are, however, different perceptions of how these changes are interrelated, and in the friction between these perceptions we may find a cue that points a bit beyond the new tools and the changing individual skills.

Some of the navigators describe the technological changes as taking over the their tasks, thus leaving them with the more passive work of simply monitoring the technology; one informant even goes so far as to say that '…this is a job that *anyone* could do, with just a little training.' The more experienced seafarers point to the problematic lack of practical experience among younger navigators climbing the career ladder much faster than was formerly the case.[6] These narratives may be understood as reflecting the same underlying development: new technologies imply a new reality in which experience needs to be gained; at the same time, structural trends of interchangeable crews and faster career moves imply less time to immerse in this reality in order to gain the experience. The view that certain jobs can be done by almost anyone due to new technologies, and that experience is so grossly underestimated, may be ascribed to alienation occasioned by these

[6] As mentioned, this was countered for anchor handlers due to the specific demands on the bridge operations there. Though formally qualified, inexperienced officers had to wait some additional years before being accepted as first officer there.

structural trends where the human factors and competence in sociotechnical systems is under-communicated[7].

These trends need to be considered when reflecting upon the scope of seamanship. Even though seamanship is a multifaceted concept (Bye et al., 2015), *individual* skills are an important part. This includes professional skills and competence, but also the individual seafarer's cooperation skills and abilities in upholding social relationships (Knudsen, 2009; Antonsen, 2009) However, developments within the maritime world, and the way knowledge and competence is increasingly situated and administered as organisational assets, suggest that knowledge and competence are increasingly embedded with *systems*, technologies and infrastructures through which they act and interact. These systems not only include social relations, artefacts and technologies on board the ships, but also relations stretching far beyond the ships, such as corporate, national and international regulations. Situated action on a ship is increasingly connected, for example to data analysts, managers or planners on shore. This network, or system, should be understood in light of the increasing legal requirements for a systematic and accountable approach to performance and safety and the tools and technologies for making this possible.

If the content of seamanship shall have relevance in such a systemic context, it needs to take into account these requirements and tools, as well as the ways individual seafarers interact with them and acquire experience with them. This has consequences for the unit of analysis for understanding seamanship. In aviation, where a similar development has taken place over a longer time span, *airlineship* has been suggested as a systemic or network conceptualization of airmanship (Haavik et al., 2017). In the maritime domain, we might talk of *distributed maritime capabilities*. This has consequences for a discussion of whether the classical understanding of seamanship is eroding or evolving; while the *erosion* argument lends support from a shrinking leeway for professional judgement, the *evolution* argument accounts for how professional judgement is changing, being distributed and delegated (Latour, 1992) across human and non-human 'colleagues', such as DP systems, digital maps and IMO regulations[8]. The term is inspired by Hutchins' (1995) concept of distributed cognition, developed in his study of navigation on a US Marines amphibious ship.[9]

While this evolution implies both an evolution of the empirical reality and of the theoretical tools and vocabularies accounting for this, it is worth noticing that the emic core of seamanship, with its enduring acknowledgement of time-out-of-mind aspects, is enriched rather than outdated. Many examples in our research material show this, as they point towards the intimate relationship between judgement and rules (Canadian Coast Guard, 2001), the cooperation and teamwork dimension , the technomaterial aspects (bringing to the fore the managing of improvised fuses as well as dynamic positioning systems and IT systems) – depending on a crew located both on and beyond the ship.

[7] These structural trends can also be observed in aviation, where the opportunity of gaining rich experience through a long, but slow, career ladder is inhibited as models of education, employment and career development are changing in a direction of higher pace and lower commitment.

[8] Importantly, these entities cannot be seen as 'acting alone' either, as reflected in the already cited Canadian Coast Guard manual (2001, p. 113): *"The rules are not there to replace good judgement and practice of good seamanship".* Not to replace, but to complement, we might add.

[9] Though particularly suited for modern navigation -our data have illustrated the increasing importance of technology and systems that reach beyond the ship as an immediate context. His argument concerns less technological advanced navigation and cognition. We have not elaborated the distributed dimensions of traditional seamanship here.

Apart from a term and a concept undergoing semantic changes, what difference does this process make? In the following, we shall reflect on some themes relating to the development trends and discuss their relevance for safety at sea.

5.2 From profession as ethos to profession as structured rationality

The informants' elaborations of the 'past' and 'contemporary'/'future' form of professional competence evoke thoughts of different views on profession and professionalism. While the traditional notion of seamanship aligns with professionalism understood as *ethos*—that is, the character and ideals characterising a community—the trend seems to be to describe professionalism more in terms of a *structured rationality*. The caretaking of vessels and colleagues, and the improvisation expected when managing unexpected events and demanding operations that the older generation, in particular, associates with the essence of seamanship is something that has been fostered through communities of practise. Hence, aspects of identity and belonging have also been a part of seamanship. With a transition to a structured rationality, the importance of identity and belonging is reduced; at the same time, caring and improvisation is difficult to translate into the language of structured rationality. The caring and improvisation associated with communities of practise is closely linked to trust and cultural redundancy (Rosness et al., 2010)— central aspects of high reliability organisations (La Porte & Consolini, 1991)—and while it is difficult to theorise on the quantitative impact on safety, the transition to a structured rationality is something that lends itself to qualitative and quantitative empirical research studies. Further empirical inquiries into this theme would thus be possible and important.

5.3 From tacit to explicit competence

The competence associated with seamanship is typically achieved through experience. The culture of seamanship is a culture of learning by doing that we see in so many communities of practise. This is associated with the situation that—as both a cause and a consequence—this type of knowledge is to a large degree tacit.[10] While we document many different perspectives on seamanship, we struggle hard to get beneath the general and abstract surface so as to describe this competence in an explicit, book-like fashion.

However, according to the more experienced informants, the education of seafarers is becoming increasingly theoretical and systematised. In terms of safety, going from the tacit to the explicit is a two-edged sword. As we have learned from Turner, a number of assumptions may live long and well during what, after an accident, is realised was a period of incubation (Turner & Pidgeon, 1997). Tacit, cultural beliefs may not as easily be contested, as may assumptions that are more explicit; thus, the opportunity to learn *before* something undesired happens is limited. On the other hand, the explicit part of knowledge also has numerous limitations that become clear when knowledge is turned into procedures. Sociotechnical systems and risk environments are always underspecified and procedures are always more generic than the situations they address, so adaptations and efficiency-thoroughness trade-offs—unspoken and on-the-fly—are inherent parts of the operational repertoire, and attempts to exemplify them tend to counter the intention (Polanyi, 1966).

[10] Tacit, in this context, does not mean that it is not spoken of. Seafarers have historically been, and still are, eager storytellers. The community of practice thus share experiences among themselves, for example through narratives, but in an unsystematic manner. See also Orr (1996) for a discussion of narratives as knowledge sharing in communities of practice.

5.4 From embodied to technified knowledge

The technification of the seafarers' work environment challenges the traditional reliance on embodied knowledge. We have seen how the extracting of cues from sounds, smells, vibrations and other weak signals is part of the traditional seamanship repertoire. As the rapid development in materials and machine technology take place, paired with digitalisation and automation, such signals tend to lose their significance and to be replaced by types of signals that require a completely different sensory apparatus to notice. As seafarers are increasingly becoming system operators—of systems that require increasingly cognitive-technical work at the expense of bodily/sensory interaction—traditional seamanship runs the risk of being thrown out with the bathwater. An exploration of possible negative consequences would require further research on seamanship in times of transition, with richer descriptions that are attuned to resonate with themes in safety research. One potentially fruitful direction could be to adopt a Safety II-approach and challenge the general assumption that the dynamic non-events of safety do not make themselves readily available for inspection (Reason, 2000). This would invite re-descriptions of seamanship with less focus on culture and more focus on transition.

5.5 From individual to system

The *scope* of seamanship is delimited by what seafarers are able to oversee and control. As the ship and their systems are changing, the control possibilities change as well. The informants refer to the considerable changes that have appeared in the engine room and the IT system, resulting in many things over which they no longer have control. The fixing of malfunctions often requires outside expertise from the suppliers, something that exemplifies well the systemic transition that is taking place. [11] While ships were traditionally autonomous organisational systems that the seafarers on board could—and were expected to—master alone, ships are now increasingly parts of large networks of ships, internal and external IT-systems, shipping companies, yards, certification agencies and national and international regulations. The complexity of the socio-regulatory-technical systems into which ships are increasingly woven requires increasingly complex control systems. Hence, a tendency can be observed that the scope of seamanship is scaled up to what we preliminary—for want of a better term—have called distributed maritime capabilities.

This transition might be a part of a more general development, also embracing other professions. For example, research from aviation show similar trends, where the role of pilots has gradually changed as their work is increasingly distributed over a larger number of actors in the aviation industry. The systemic variant of airmanship we have labelled airlineship (Haavik et al., 2017).

6 Conclusion

In this article we have illustrated that the traditional concept of seamanship is challenged by broad developmental trends. The introduction of new technological systems, and an increasing proceduralisation of the work, led in our study to a perception among the experienced seafarers of marginalisation of professional competence, skills and judgements. In parallel, the training and

[11] An illustrating example in the forefront of this development is that the engine room, previously authoritatively governed by the chief, is currently for some ships part of "Engine as a service" arrangements, such as Rolls Royce's Power by the Hour concept. Inspired by the airline industry, these engines are instrumented and monitored by the supplier. The engines are a service and much of their operation managed by onshore specialists from the supplier.

education was perceived as being more theoretical and generalised than before and seen as reducing the significance of the tacit knowledge inherent in seamanship.

In light of the changes, we have suggested the term distributed maritime capabilities, which includes not only the seafarers and the vessels, but the larger system of which they are a part. Importantly, though the systemic conception of distributed maritime capabilities, point beyond the capabilities of individuals and the single vessels, they are also descriptive of the situations where new individual competencies and values emerge. These include a notion of knowledge and competence being embedded in technology, procedures, regulations and seafarers as a holistic system. Seeing capabilities as distributed directs analytical attention to the role of structured rationality, explicit knowledge and human-technology interaction.

Our informants' descriptions of traditional seamanship make it something of a black box. As a label for a type of competence and practise that ensures safe operations at sea, seamanship reveals little of the concrete modus operandi and the possibilities to formalise this. However, if we consider the catchment area and the heterogeneity of distributed maritime capabilities, this is no less of a black box, only a much larger one: our informants' descriptions of a structured rationality, explicit competence and a technified and systemic environment calls for continued studies of distributed capabilities, with a particular aim to describe how the systems actually work. A systemic work-as-done description would be challenging, but also an inspiring ambition that could ensure the relevance of seamanship, the age of technology and standardisation.

The limitations of the study are first and foremost related to the number of informants and the delimitation to offshore vessels. Whether the concept resonates with the maritime industry in general should be further explored. As mentioned, a parallel concept has been developed in aviation ('airlineship'), supporting that it might be a fruitful concept to explore further also in the maritime context. How the development to more distributed capabilities influences maritime safety is also a topic that should be addressed further. There are studies that link the bureaucratic burden of navigators caused by proceduralisation to lower safety levels and an increase in ship accidents (e.g., Knudsen, 2009; Størkersen et al., 2017). Still, new technological aids for navigation and monitoring should contribute positively to maritime safety. The 'net effect' of the changes we have addressed and of what we have denoted 'distributed maritime capabilities' is still unknown and knowledge of this remains important for improving maritime safety.

One beneficial implication of focusing on distributed capabilities from the industry perspective is the including of attention to the system level. This can expand and supplement the individual focus evident in for example human-machine interaction and ergonomics, and also include how humans and technology are parts of a wider system, involving rules and procedures, training regimes etc., and how a system as a whole should work to support maritime safety. Distributed capabilities as a concept might also bring unintentional, and sometimes negative consequences of the development in the maritime industry to the front.[12] Some seafarers in our study do not regard 'seamanship' to be of relevance to them. It could be beneficial to coin a new concept that embrace contextual developments in the maritime industry.

[12] The airline industry has seen the Boing 737 Max accidents, caused by automation failures, in these such distributed capabilities. The causes for the near catastrophic engine shut down of Viking Sky in heavy weather on the Norwegian cost in a similar manner could be attributed to automation, as automatic systems shut the engines due to low oil level readings caused by heavy waves. The ability to understand, prevent and manage such problems may be a necessary skill for seafarers in times to come.

References

Admiralty. (1908). Manual of Seamanship Volume I. HM Stationery Office, London.

Antonsen, S. (2009). The relationship between culture and safety on offshore supply vessels. Safety Science 47(8), 1118.

Antonsen, S., Almklov, P., Fenstad, J. (2008). Reducing the gap between procedures and practice: Lessons from a successful safety intervention. Safety Science Monitor 12(1).

Aubert V., Arner O. (1959) On the social structure of the ship. Acta Sociologica 3(4), 200–219.

Bieder, C., Bourrier, M. (Eds.). (2013). Trapping Safety into Rules. How Desirable or Avoidable is Proceduralization? Ashgate, Farnham.

Bhatta. G. (2003). Intent, risks and capability: some considerations on rethinking organizational capability. International Review of Administrative Science, 69 (3), 401-418.

Bryman, A. (2012). Social research methods (4th edition). Oxford: Oxford University Press.

Bye, R. J., & Aalberg, A. L. (2020). Why do they violate the procedures? – An exploratory study within the maritime transportation industry. Safety Science, 123, 104538.

Bye, R.J., Antonsen, S., Lamvik, G.M. (2015). Godt sjømannskap - Ferdigheter og yrkesidentitet. [Good seamanship – Skills and professional identity] In: Antonsen, S., Kongsvik, T.: Sikkerhet i Norske Farvann. [Safety in Norwegian Waters]. Gyldendal Akademisk, Oslo.

Canadian Coast Guard Auxiliary, Canadian Coast Guard Marine SAR Programs. (2011). Search & Rescue Crew Manual. Queen's Printers, Victoria, BC.

Crabtree, B., Yanoshik, M., Miller, W. & O'Connor, P. (1993). Selecting individual or group interviews. In Morgan, D. L. SAGE Focus Editions: Successful focus groups: Advancing the state of the art (pp. 137-150). Thousand Oaks, CA: SAGE.

Danton, G. (1996). The Theory and Practice of Seamanship (11th ed.). Routledge, New York, NY.

Dekker, S. (2003). Failure to adapt or adaptations that fail: Contrasting models on procedures and safety. Applied Ergonomics 343, 233–238.

Fournier, V. (1999). The appeal to 'professionalism' as a disciplinary mechanism. The Sociological Review 47(2), 280–307.

Gilmore, G., Black, C.L. (1975). The Law of Admiralty. Foundation Press, New York, NY.

Goffman, E. (1961). Asylums. Penguin Books, New York, NY.

Haavik, T.K., Kongsvik, T., Bye, R.J., Røyrvik, J.O.D., Almklov, P.G. (2017). Johnny was here: From airmanship to airlineship. Applied Ergonomics 59, 191–202.

Hale, A., Borys, D. (2013). Working to rule, or working safely. In: Bieder, C., Bourrier, M. (Eds.), Trapping Safety into Rules. How Desirable or Avoidable is Proceduralization? 43-68. Ashgate, Farnham.

Hollnagel, E. (2009). The ETTO principle: Efficency-Throughness Trade-Off. Ashgate, Farnham.

Hollnagel E., Woods, D. and Levenson, N. (2006). Resilience Engineering: Concepts and Precepts. Ashgate, Hampshire.

Hutchins, E. (1991). The social organization of distributed cognition," In: Lauren B, Resnick, John M, Levine, and Stephanie D, Teasley (eds,). Perspectives on Socially Shared Cognition: 283-307, Washington, DC: American Psychological Association.Hutchins, E. (1995). Cognition in the Wild. MIT Press, Cambridge, MA.

IMO (1972). Convention on the International Regulations for Preventing Collisions at Sea, http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/COLREG.aspx

Knudsen, F. (2009). Paperwork at the service of safety? Workers' reluctance against written procedures exemplified by the concept of 'seamanship'. Safety Science 47(2), 295–303.

Kongsvik, T., Størkersen, K.V., Antonsen, S. (2014). The relationship between regulation, safety management systems and safety culture in the maritime industry. In: Steenbergen, R.D., van Gelder, P.H.A.J.M., Miranglia, S., Vrooumwenvelder, A.C.W.M. (Eds.), Safety, Reliability and Risk Analysis: Beyond the Horizon, pp. 467–473. CRC Press, Leiden.

Lamvik, G.M. (2002). The Filipino seafarer: A life between sacrifice and shopping. Department of Social Anthropology, Norwegian University of Science and Technology, Trondheim.

La Porte, T.R., Consolini, P.M. (1991). Working in practice but not in theory: Theoretical challenges of high reliability organizations. Journal of Public Administration Research and Theory 1(1), 19–47.

Lamvik, G.M., Bye, R. (2004). National culture and safe work practice—A comparison between Filipino and Norwegian seafaring professionals. In Spitzer, C., Schmocker, C., Dang, V., Vinh, N. (eds). Probabilistic Safety Assessment and Management, pp. 1315–1321. Springer, London.

Latour, B. (1992). Where Are the missing masses? The sociology of a few mundane artifacts. In Bijker, W.E., Law, J. (Eds.), Shaping Technology/Building Society: Studies in Sociotechnical Change, pp. 225–264. MIT Press, Cambridge, MA.

Lindbom, H., Tehler, H., Eriksson, K., & Aven, T. (2015). The capability concept – On how to define and describe capability in relation to risk, vulnerability and resilience. Reliability Engineering & System Safety, 135, 45-54. https://doi.org/10.1016/j.ress.2014.11.007

Mclaughlin, J., Webster, A. (1998). Rationalising knowledge: IT systems, professional identities and power. The Sociological Review 46(4), 781–802.

Nonaka, I., Takeuchi, H. (1995). The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation. Oxford University Press, Oxford.

Orr, J. E. (1996). *Talking about Machines: An Ethnography of a Modern Job*. Cornell University Press.

Polanyi, M. (1966). The Tacit Dimension. Doubleday & Co., Garden City, NJ.

Power, M. (2007). Organized Uncertainty. Designing a World of Risk Management. Oxford University Press, Oxford.

Prison, J., Dahlman, J., Lundh, M. (2013). Ship sense—Striving for harmony in ship manoeuvring. WMU Journal of Maritime Affairs 12(1), 115–127.

Reason, J. (2000). Human error: Models and management. BMJ 320(7237), 768–770.

Rosness, R., Grøtan, T.O., Guttormsen, G., Herrera, I.A., Steiro, T., Størseth, F., Tinmannsvik, R., Wærø, I. (2010). Organizational accidents and resilient organizations. Six perspectives. Revision 2. Sintef, Trondheim.

Saldaña, J. (2016). The coding manual for qualitative researchers. London: SAGE Publications Ltd.

Serck-Hanssen, C. (1997). The construction of distance and segregation onboard ships with mixed crew. Speech presented at the 4th International Symposium on Maritime Health, Oslo.

Størkersen, K.V., Antonsen, S., Kongsvik, T. (2017). One size fits all? Safety management regulation of ship accidents and personal injuries. Journal of Risk Research 20(9), 1154–1172. doi:10.1080/13669877.2016.1147487

Størkersen, K.V., Bye, R.J., Røyrvik, J.O.D. (2011). Sikkerhet i fraktefarten. Analyse av drifts- og arbeidsmessige forhold på fraktefartøy. [Safety in coasting. An analysis of operational and work-related conditions on cargo vessels]. Studio Apertura, NTNU, Trondheim.

Turner, B.A., Pidgeon, N.F. (1997). Man-Made Disasters. Butterworth-Heinemann, Boston.

Vandeskog, B. (2016). Arbeidslag-spillets estetikk og evnen til å forutse. [Estetics of work team play and the ability to foresee] *Norsk antropologisk tidsskrift*, *27*(03-04), 229-246.

Wahl, A.M., Kongsvik, T. (2018). Crew resource management training in the maritime industry: A literature review. WMU Journal of Maritime Affairs, 17, 377-396.

Wahl. A. M., Kongsvik, T., Antonsen, S. (2020). Balancing Safety I and Safety II: Learning to manage performance variability at sea using simulator-based training. Reliability Engineering & System Safety, 195.

Wildavsky, A. (1988). Searching for Safety. Transaction Press, New Brunswick, NJ.