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Bureaucracy overload calling for audit implosion

A sociological study of how the International Safety Management Code affects Norwegian coastal transport

Doctoral thesis

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NTNU
Norwegian University of Science and Technology
Thesis for the Degree of
Philosophiae Doctor
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I sometimes reflect upon that. We've got the papers in order, but is it really better? Do we only produce paper?... The Maritime Authority's statistics are as bad as before, we run ashore just as much.
Captain, passenger vessel

Summary

Safety management regulation with functional rules and internal controls offer potential for practical procedures. It makes companies primarily responsible for their own safety by implementing and internally controlling safety management systems, with regulators required only to audit the systems. A movement toward deregulation combined with controls are part of why our *audit society* has experienced an *audit explosion* (Power, 2007). Parallel, most research on safety management systems emphasizes that they are experienced as complicated for companies to implement, for operational personnel to use, and for auditors and regulators to control.

The International Safety Management (ISM) Code is the maritime industry's safety management regulation with internal control. Earlier research has shown that the ISM Code does contribute to improved safety thinking and measures, but it also imposes administrative burdens and problematic procedures that could be improved with greater management commitment or seafarer involvement. The ISM Code has been mandatory in Norwegian coastal transport since 1998. During this period, personal injuries have decreased on transport vessels along the Norwegian coast, while ship accidents have increased.

The ambiguities displayed by both research and empirical outcomes demonstrate the need for this dissertation, which examines the ISM Code's influence on safety-related decision making in Norwegian coastal transport. It is a sociological qualitative, abductive, and explanatory case study. My coworkers and I have carried out field studies and interviewed 83 people in the Norwegian maritime industry—regulators, interest organization consultants, company management, and operational personnel. The vessels studied are Norwegian owned and registered, high-speed passenger vessels, bulk, general cargo, and live fish carriers operating along the Norwegian coast.

My study poses three research questions about how the ISM Code influences the Norwegian Maritime Authority, ship-owning company management, and seafarers. The research questions are explored in four published research articles through theories about safety, decision making, organizations, regulation, and accountability.

The findings regarding regulators underline their devotion to ISM compliance while also revealing that they are constrained by political and industry actors to make decisions according to business-based criteria. In addition, internal control regulation severely limits regulators' discretionary space, as they do not control the content of companies' safety management systems. They translate traditional inspections of quality in companies into audits of the existence and use of safety management systems.

Managers are motivated by the ISM Code to make safety investments. However, criteria of profit making, accountability, and internal control can cause managers to make decisions as if they had less discretionary space than stated in the ISM Code. Companies purchase easily auditable, standardized systems that are more complex than suiting for coastal transport vessels.

Seafarers are constrained differently by the complicated and general safety management systems: Operational managers—navigators—translate safety management systems into practice for the operational personnel, which has a negative influence on the navigators' safety-

related decision making and a positive influence on other seafarers. The translation provides operational personnel with systematic safety awareness and routines that may well decrease personal injuries. It also results in a heavy workload and documentation burden for the operational managers and thus less concentration and limited situational awareness of their main operations, and can contribute to ship accidents.

Overall, internal controls, documentation, and auditing constrain the safety-related decision making of regulators, management, and seafarers, thus ironically leading to results that run counter to the ISM Code's objective of ensuring maritime safety. The core paragraphs of the ISM Code are beaten by its parts about documentation and verification. Companies have to implement easily auditable safety management systems, which can complicate the procedures. Hence, simple function-based rules like the ISM Code cannot be transformed into simple safety management in the companies.

These results about core objectives being overshadowed by auditability demands might not be restricted to the ISM Code and coastal transport. It rather can be a symptom of the *audit society* as a whole, and illustrate how bureaucracy escalates even though policymakers and other actors talk about the necessity to avoid it. Many areas of society might gain by decreased auditability and increased value of un-auditable activities, like some operational seafarers enjoy.

To unlock the full potential for safety management with practical procedures, thus, will require an *audit implosion*. Regulators, companies, and operational personnel would benefit by safety measures less concerned with auditability and more focused on safety itself.

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The informants—regulators, company management, support organizations, and seafarers—deserve my greatest gratitude. Without their reflections and hospitality, this thesis would not have been possible.

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Since this thesis is based on articles, parts of this text have therefore been indirectly composed by the co-authors of Articles A–D (Trond Kongsvik, Stian Antonsen, Petter Almklov, and Ragnar Rosness).

Thanks to all my other coworkers and organizational and maritime scholars. Every time I read your work, I see new aspects that are relevant to this thesis, and I regret that the scope of a thesis prevented me from incorporating all of your insights.

Contents

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1 Introduction

Most vessel operations are carried out without injuries or ship accidents (Schröder-Hinrichs, Praetorius, Graziano, Kataria, & Baldauf, 2016, p. 178). This is due to the safety-related decision making of the personnel on board, which is influenced by the actors and conditions surrounding them (Rosness, Blakstad, Forseth, Dahle, & Wiig, 2012). This thesis studies safety-related decision making in Norwegian coastal vessels and its relation to the International Safety Management Code (ISM Code) to gain knowledge of reasons for and consequences of organizational safety management procedures and practices.

1.1 Maritime safety regulation

It is indisputable that the vast majority of seafarers operate daily without accidents, even though working at sea is inherently dangerous and at times highly challenging. Historically, maritime accident statistics have been grim (Bhattacharya, 2009, p. 8). Maritime transport has been called error-inducing because of a combination of problematic conditions (Perrow, 1999). Important elements that trouble contemporary maritime decision making are social organization, economic pressure, and the structure of the industry (Hetherington, Flin, & Mearns, 2006). Globalization challenges the conditions that are crucial to maintaining safety, such as labor rights, operating standards, and governmental control (Bhattacharya, 2009, p. 25). Vessels can operate in one area, be registered in a state far away, be owned by a company from elsewhere, have a crew from yet another state, and carry cargo or passengers from every part of the world. Charterers can choose between a variety of vessels and are usually not interested in paying extra for safety (Sampson, Walters, James, & Wadsworth, 2014).

Regulation has been reported to be important in reducing the impact of market mechanisms and preventing accidents (J. Rasmussen, 1997; Reason, 1997; Walters et al., 2011). States regulate industries to ensure values such as fairness and safety for companies, employees, and society as a whole (Baldwin, Cave, & Lodge, 2011; Lindøe, Kringen, & Braut, 2012; Thomassen, 1993). To ensure that regulations actually reach the personnel performing each task, it has been common in recent decades for governments to oblige companies to create safety management systems with procedures that the operational personnel must follow. In the globalized maritime industry, this approach has been applied internationally.

The International Safety Management Code was adopted in 1993 and has since been effected in maritime states and sectors (IMO, 2017c). ISM holds ship owners responsible for safety in their activities and makes them implement functioning safety management systems. The systems must contain procedures for how personnel should work to ensure the company's safety and environmental policies are followed and how to document and audit this compliance. National regulators issue ISM certificates for their vessels and control the systems on national-

registered and visiting vessels. Many actors consider this approach a failure, because national states are not sanctioned if they lack high-quality control, so ship owners can choose low safety standards when they choose the state in which to register their vessels in (O. F. Knudsen & Hassler, 2011; M. S. Roe, 2008, 2013). In addition, the ISM Code is formulated such that audits are not about the content of onboard safety management systems; instead, they only ensure that the required topics are covered and that a system is in place and used. Nevertheless, the Norwegian Maritime Authority "finds systematic safety management to be an important instrument in order to prevent accidents" (Maritime Authority, 2016, p. 9).

Research on the effectiveness of the ISM Code shows that it contributes to safety but also has significant weaknesses. Safety thinking and measures have been improved, but there is a need for a reduction in administrative burdens, greater commitment from the top, and more involvement of seafarers in the development of procedures and reporting (Anderson, 2003; Bhattacharya, 2012; Lappalainen, 2016; Lappalainen, Vepsäläinen, & Tapaninen, 2010; Oltedal, 2011). This is in line with other research results, both generally and for seafaring specifically, showing safety management systems to be both helpful for and counter to safety (e.g., Bieder and Bourrier (2013); Grote (2012); Hale and Borys (2013a); F. Knudsen (2009)).

1.2 Knowledge gaps and research questions

To enforce policies or propose changes to move them in the most suitable direction it is essential to understand how they work. Maritime safety regulation researchers have specifically called for more qualitative knowledge about seafarers' opinions on policies (Kuronen & Tapaninen, 2010), how safety management systems influence operations (Bennett, 2000), and the implementation of the ISM Code in general (Xue, Walters, & Tang, 2015).

Norwegian research over the last decade has portrayed safety management systems as troubled. Maritime transport's problematic relation to procedures has been exhaustively described (Aalberg & Bye, 2017; Almklov & Antonsen, 2010; Antonsen, Almklov, & Fenstad, 2008; Bye & Lamvik, 2007; Bye, Røyrvik, & Lamvik, 2012; Håvold, 2010; Oltedal, 2011; Røyrvik, Skarholt, Lamvik, & Jonassen, 2015; Soma, 2004b; Størkersen, 2017; Vandeskog, 2015). There is also research in related industries about companies' legitimation of safety management systems (Almklov & Antonsen, 2014; Antonsen, Skarholt, & Ringstad, 2012; Dahl, 2014; Lindøe, Baram, & Braut, 2011; K. A. Pettersen, 2013; Rosness, 2013) and regulators' problems in controlling safety management systems (Antonsen, Nilsen, & Almklov, 2017; Engen, 2014; Kongsvik, Gjøsund, & Vikland, 2016; Lindøe & Engen, 2013; Lindøe, Engen, & Moen, 2011). In addition, Norwegian coastal transport has puzzling statistics, with increasing ship accidents and decreasing personal injuries (see Figure 4 in Section 2.2.3). These studies and real-world results make it imperative to know more about safety regulation and its enforcement and implementation in Norwegian coastal transport.

Despite the negative picture of procedures and the bewildering statistics, the ISM Code and its implications for Norwegian coastal transport have not been much studied. One knows little about how safety management is enforced by national regulators, how companies create

safety management systems, and how safety management influence operations in practice. It is therefore necessary to study how Norwegian regulators, company management, and seafarers relate to the ISM Code and how it influences their work.

However, we know that how regulations are implemented and used is subject to many influences. Profit and market forces, for example, can influence compliance as strongly as regulation (Sampson et al., 2014) : "To understand how governance and regulation works it is important to get to know the perceptions of personnel and managers," since the "understanding seafarers and managers have of the regulation impact their practices" (Sampson et al., 2014, p. 385). To find out how they are influenced by the ISM Code, directly or indirectly, it is thus necessary to learn how seafarers, company management, and regulators understand their entire situation when making safety-related decisions. The concept *safety-related decision making* is defined in this thesis' Section 3.1.4 by drawing on the literature review in Chapter 3:

> Safety-related decision making is decision making involving critical aspects of potential safety, usually in work situations involving groups of workers at one or more levels of an organization – during operations, management, rule enforcement and other activities. Safety-related decision making is closely associated to critical safety aspects or carried out in situations which can lead to or prevent accidents with at least one of Rasmussen's (1997) three safety elements: personal, economic, or environmental failure.

The context of safety-related decision making on different levels is of crucial importance, because that context shapes the decision making. Organizational contexts are framed by culture, structure, interactions, relations, and technology (Schiefloe, 2017; Schiefloe & Vikland, 2006). One must analyze the decision making in its actual situation to determine what influences it. Regulators will be affected differently by the ISM Code than company management is. One goal of this thesis is to obtain a picture of the practical implementation and translation between the various levels at play in Norwegian coastal transport. At each level and in each organization where a regulation is implemented, it will be translated and understood differently (Czarniawska & Sevón, 1996; Røvik, 2007). Only by understanding what influences maritime decision making situations can one get a grasp on how they are affected by the ISM Code. Still, it is not possible to comprehend all relationships. However, it is still worthwhile to analyze the big picture of decision making to obtain an idea of how the ISM influences the Norwegian coastal transport safety situation. This can even give some general knowledge about contemporary organizational safety management, also relevant for other sectors. In this thesis I therefore ask:

> How is safety-related decision making in Norwegian coastal transport affected by the International Safety Management Code?

This problem formulation is explored through three research questions, discussed in combination or on their own in four papers. These research questions (RQ1–RQ3) are theoretically abducted after previous research is presented in Chapters 3 and 4:

1. How is regulators' safety-related decision making affected by the International Safety Management Code?
2. How is company management's safety-related decision making affected by the International Safety Management Code?

3. How is operational personnel's safety-related decision making affected by the International Safety Management Code?

1.2.1 Operationalization

The fundamental idea of this thesis is illustrated in Figure 1. Safety-related decision making is influenced by environmental conditions of all kinds, including regulations and the market. The ISM Code was crafted in the political arena and affects decision making even at the lowest levels. It influences national regulators' safety-related decision making, especially how they enforce the Code. This enforcement is supposed to influence company management's decision making, particularly their development of safety management systems. Safety management systems are intended to influence operational personnel's safety-related decision making, which is essential for avoiding accidents and injuries in operations.

In this thesis, research from several fields is employed to shed light on safety-related decision making at these different levels. The ISM Code can also influence each level directly, without being transformed through the various levels, but this this factor is not a focus of the thesis.

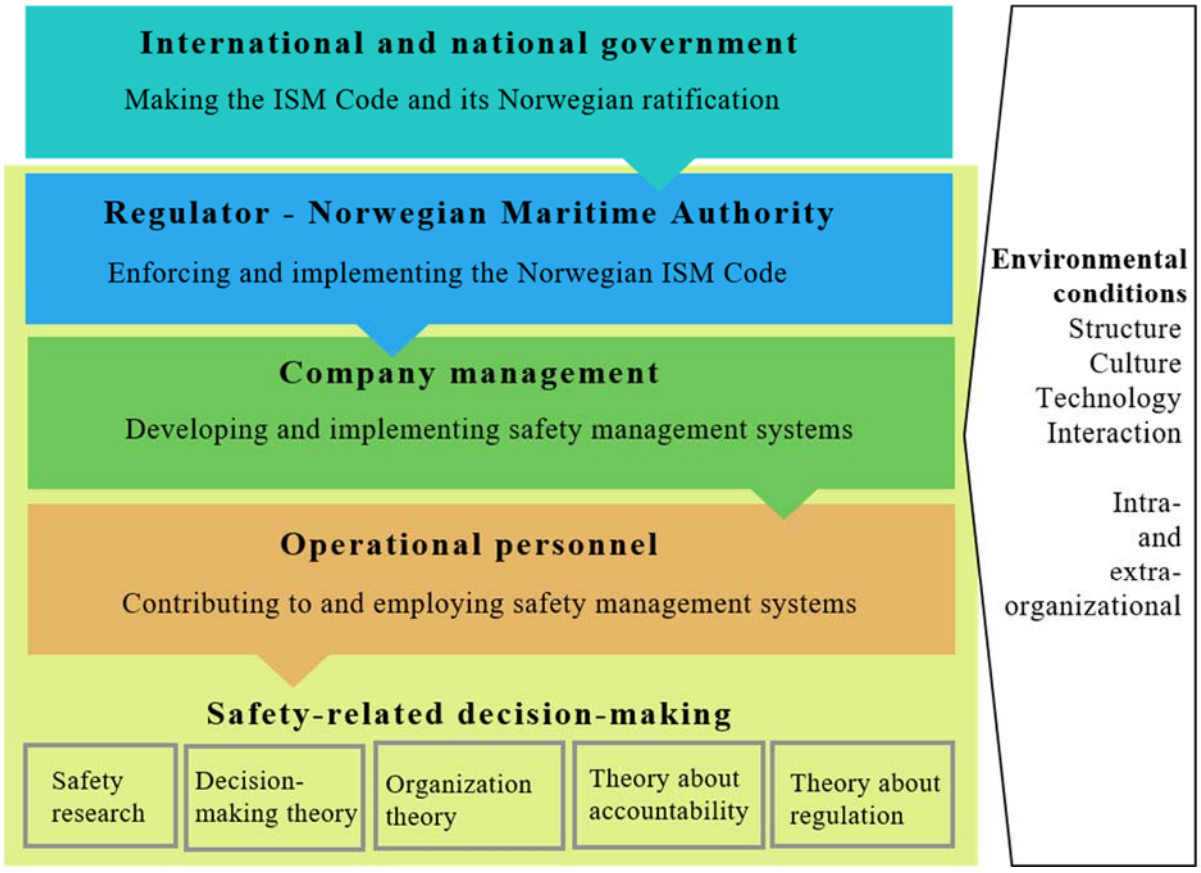

Figure 1: Environmental conditions influence decision making. The ISM Code was developed by political actors and affects decision making at the lower levels. A combination of research sheds light on the levels' safety-related decision making.

The core data consist of interviews with and observations of representatives from the Maritime Authority, the Coastal Administration, four counties, eight ship owner company offices, an interest organization, and forty-three maritime crewmembers on thirteen vessels (see Table 6).

The data have been analyzed to understand how the actors on the three levels make safety-related decisions. The research questions are explored in four research articles (Table 1).

Table 1: The three research questions in this dissertation are discussed in four articles

No	Title	Regulators – RQ1	Management – RQ2	Crew – RQ3
A	Survival versus safety at sea. Regulators' portrayal of paralysis in safety regulation development *K.V. Størkersen. 2015. Safety Science 75, pages 90-99*	■		
B	One size fits all? Safety management regulation of ship accidents and personal injuries *K.V. Størkersen, S. Antonsen, T.Ø. Kongsvik. 2017. Journal of Risk Research, 20 (9), pages 1154-1172*	■	■	■
C	When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge? *P.G. Almklov, R. Rosness, K.V. Størkersen. 2014. Safety Science 67, pages 25-36*		■	■
D	Fish first. Sharp end decision-making at Norwegian fish farms *K.V. Størkersen. 2012. Safety Science 50 (10), pages 2028-2034*			■

The overarching findings suggest that the ISM Code's parts regarding control overshadow its aim of ensuring sea safety, because of practices of auditing and implementing safety management systems. The decision making of seafarers with administrative responsibilities is negatively influenced by extensive safety management systems, while the decision making of seafarers without administrative tasks is influenced positively by translated safety routines and systematic safety knowledge. This can illustrate how bureaucracy escalates in safety management and other parts of society, even though un-auditable tasks should be valued.

1.3 Structure of the thesis

Chapter 2 is a presentation of the field studied in this thesis. It covers the ISM Code and related regulations, along with key organizations and statistics related to Norwegian coastal transport. Previous literature is the focus of Chapters 3 and 4. Chapter 3 introduces the most important theoretical concepts used in this thesis, such as safety, decision making, regulation, and accountability. The term safety-related decision making is defined in Section 3.1.4. Chapter 4 reviews earlier research concerning how regulation influences safety-related decision making on several organizational levels. For the levels of regulators, management, and operations, I derive three research questions to operationalize the problem addressed in this study.

Methodological considerations are presented in Chapter 5; I describe the research design, study information, and ethical and scientific matters. The findings are presented in Chapters 6 to 8. The four research articles are summarized in Chapter 6. The findings related to the research questions are discussed in Chapter 7. In Chapter 8, the findings are summarized, conclusions drawn, and implications for the industry and further research discussed. Throughout this thesis, the term *regulation* is understood broadly to include laws, rules, and enforcement.

2 Norwegian coastal transport

This chapter describes the translations of the ISM Code and its audits before presenting the key actors in Norwegian coastal transportation that are studied in this thesis. The main actors and regulations are illustrated in Figure 2. As with all parts of the sea, the Norwegian coast is internationally regulated: international organizations create conventions that are adapted to national regulations. The regulations are intended to trickle down through the regulators and associations to maritime companies and practical operations.

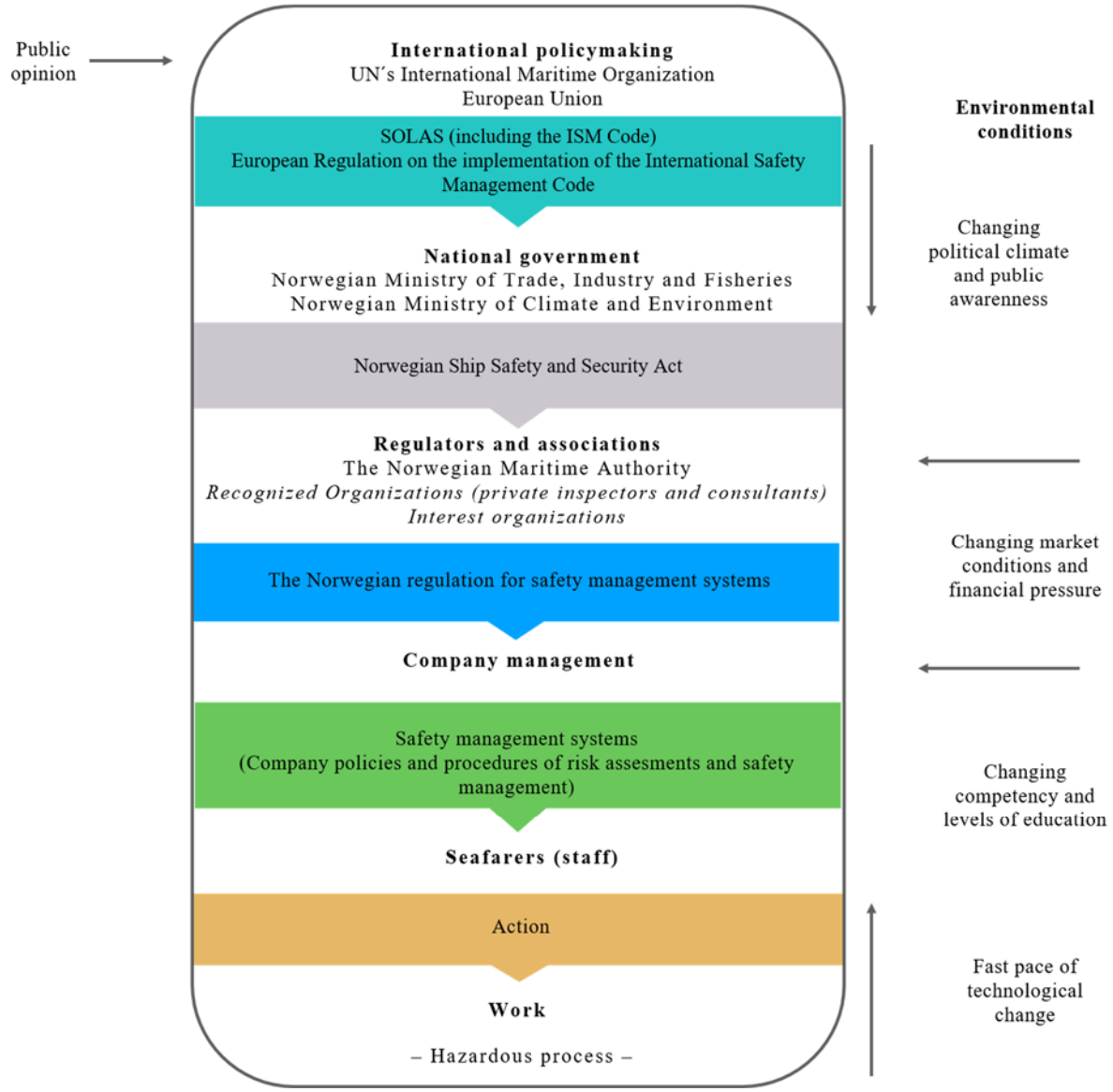

Figure 2: Illustration of the ISM Code's chain of accident prevention in Norwegian coastal transport, inspired by Rasmussen's socio-technical system (J. Rasmussen, 1997, p. 185)

2.1 Regulation and control of the Norwegian coast

Safety management regulation imposed on Norwegian coastal transport vessels consists of international, continental, and national guidelines and regulations. The core regulation is the ISM Code, which was ratified in the Norwegian Ship Safety and Security Act (Norwegian Ship Safety and Security Act, 2007). These acts, with sub-regulations, are presented in this section and summarized in Table 2.

Table 2: International and Norwegian maritime safety regulations

International	European	National Act	National sub-regulation
The International Convention for the Safety of Life At Sea (SOLAS), including Chapter IX on the ISM Code See Appendix I for the entire ISM Code	European Regulation… on the implementation of the International Safety Management Code…	Norwegian Ship Safety and Security Act *Examples relevant for safety management:* *§ 7: Every vessel must have a safety management system that is adapted to its activities. Shipmaster and crew must contribute to the content and function of the safety management system.* *§ 15: A ship must be "staffed in a safe manner."*	Norwegian regulation for safety management systems *Example showing it is exactly the same as the ISM Code Chapter in SOLAS:* *Safety management objectives of the Company should be, inter alia:* *1. provide for safe practices in ship operation and a safe working environment;* *2. assess all identified risks to its ships, personnel and the environment and establish appropriate safeguards; and* *3. continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection.*

2.1.1 The ISM Code and its development

International maritime agreements have been championed since the nineteenth century. In early times, whether a ship was safe depended on its seaworthiness and its crew's seafaring skill, but this was difficult to control with any uniformity (Soma, 2004a). In 1914, following the loss of *Titanic*, the first Convention for the Safety of Life at Sea (SOLAS) was agreed upon internationally. Early regulation covered many aspects related to safety, such as technical qualities of cargo, the vessels themselves, ship owners, market and contract relationships, insurance, and personnel certificates. "From focusing on the technical and regulative subjects, the trend the latest 25 years have been to address the company behind the ships. It has been common to state that behind any Sub-Standard ship there is a Sub-Standard owner or manager" (Soma, 2004a, p. 13). Sub-standard means that a ship's vital parts or lifesaving equipment are substantially below the standards of national or international regulation. In the 1990s, the international maritime community, including the International Maritime Organization (IMO), saw the need for comprehensive safety regulations that covered safety management in companies and on vessels.

The International Management Code for the Safe Operation of Ships and for Pollution Prevention was adopted by the IMO in 1993 and has since been amended (IMO, 2017c). In 1998, it was made mandatory for most passenger and cargo ships of 500 gross tonnage or more, and in 2002 for other large cargo ships and mobile offshore drilling units on international voyages or in international operation were added. The Code is often shortened to the International Safety Management Code or ISM Code. The entire ISM Code is attached as

Appendix I. For a historical overview and more detailed descriptions of the establishment of the ISM Code, see, for example, Anderson (2003), Bhattacharya (2009, 2012), Christophersen (2009), and Lappalainen (2016).

The function of the ISM Code

The main objectives of the ISM Code are ensuring "safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment" (IMO, 2017c). The guidelines go on to state that ship owners' objective should be to provide *systems* for safe practices, risk assessments, and safeguards, and to "continuously improve safety management skills of personnel ashore and aboard ships." (the ISM Code's objectives, § 1.2.2, see Appendix I).

The ISM Code is a functional requirement that sets goals that regulated companies should achieve, without offering a detailed prescription of how to achieve them. The code is built on the values of accountability and total quality management, stressing management commitment, personnel empowerment, and auditing as means of improvement (Lappalainen, 2008). The ISM Code can be said to be an internal control regulation of the kind that have become common in our "audit society" (Power, 1999). In Norway, land-based industries' internal control regulation is called *The regulation of systematical work with health, environment, and safety in companies;* it demands company owners to establish and update functional safety management systems (Saksvik, Torvatn, & Nytrø, 2003). Internal control regulations are typically function-based and written in general and brief language such as that found in the ISM Code. The Code in total is only nine pages with regular font. Less than three pages are used to describe the safety management system, while four are used on control and certification processes.

The central part of the ISM Code is a tool to assure its objectives, namely that companies shall develop, implement, and maintain a *safety management system*. Safety management systems must ensure compliance with all relevant rules, codes, standards, and so on, for all vessels: "*Safety management system* means a structured and documented system enabling Company personnel to implement effectively the Company safety and environmental protection policy." (the ISM Code § 1.1.4). The system must include a safety and environmental protection policy and instructions and procedures to comply with that policy, authority structures and communication paths in the companies, reporting of non-conformity, emergency preparedness, and internal audits (IMO, 2017c). This is usually manifested in procedures for specific activities that the personnel should carry out, how to perform them and, in many cases like maintenance, how often to do them. In practice, other regulations are also included in a safety management system, often involving industrial standards or customer requirements. Most vessels have an electronic safety management system in addition to paper copies and logbooks.

2.1.2 ISM in Norwegian law

The ISM Code has been statutory for Norwegian commercial vessels since 1999 through Norwegian ratification and is now a part of the Norwegian Ship Safety and Security Act (Norwegian Ship Safety and Security Act, 2007) and a more detailed sub-regulation.

Text box 1: Other regulation of maritime safety

The International Maritime Organization

The International Convention for the Safety of Life at Sea (SOLAS). Chapter IX of the SOLAS is The International Management Code for the Safe Operation of Ships and for Pollution Prevention (the ISM Code), adopted in 1993, made mandatory from 1998.

The International Convention for the Prevention of Pollution from Ships (MARPOL)

The International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)

Convention on the International Regulations for Preventing Collisions at Sea (COLREGs)

Much of the above was ratified in The Norwegian Maritime Code (Norwegian Maritime Code, 1994).

The International Labour Organisation

The 2013 Maritime Labour Convention or MLC (Maritime Labour Convention, 2013) concerns sound working conditions and labor rights for the seafarers. Ship owners include it in their SMS, so the MLC is intertwined with the ISM Code when studying decision making. The MLC was ratified in the Norwegian Ship Workers' Act (Norwegian Ship Work Act, 2013).

Guidelines on occupational safety and health management systems (2001) – rarely used in the maritime industry.

The International Organization for Standardization (ISO)

is working on a standard for occupational health and SMS (Rosness, Foss, Nilsen, Almklov, & Kongsvik, 2016)

For more about maritime safety policies, see, for example, Kuronen and Tapaninen (2010) and M. S. Roe (2008, 2013).

In the sub-regulation, the Regulation for Safety Management Systems on Norwegian Ships (Norwegian regulation on safety management systems for vessels, 2015), the ISM Code is translated almost verbatim to Norwegian. It also includes the European Union's Regulation (EC) No 336/2006 of the European Parliament and of the Council of 15 February 2006 on the implementation of the International Safety Management Code within the Community and repealing Council Regulation (EC) No 3051/95. There are no differences between the Norwegian regulation for safety management systems (Norwegian regulation on safety management systems for vessels, 2015) and the ISM Code.[1] When I refer to the ISM Code in this thesis, I am including this Norwegian sub-regulation.

The overarching Norwegian law, however, adds one element to the ISM Code, namely the element of crew participation. The object of the Ship Safety and Security Act (§ 1) is "to ensure safe lives and health, environment and material values by facilitating for good ship safety and safety management, including preventing pollution from ships, ensure a fully sound working environment and safe working conditions on board the ship, and good and up-to-date supervision" (Norwegian Ship Safety and Security Act, 2007). For interpretations beyond the lay level of this act and its background, see T. H. Pettersen and Bull (2010). § 2 emphasizes that this law is mandatory for all Norwegian vessels everywhere and all ships in Norwegian waters and areas. Chapter 2 is called "The Company's duties. Safety management" and includes the essentials of the ISM Code. The major difference between the Code and Norwegian law is in part of § 7 (see also Table 2): "Shipmaster and crew must contribute to the content and function of the safety management system." Worker participation is an important legacy of Norwegian labor traditions.

[1] There is a difference in application: Norwegian regulations make the ISM Code mandatory for fishing vessels over 500 gross tonnage and domestic operating passenger vessels of any tonnage if they are certified for at least 100 passengers in domestic operation or 12 passengers in international operations, or roll-on/roll-off (RORO) ferries certified for more than 12 passengers.

2.1.3 Control of compliance

The ISM Code states that ship owners are responsible for safety on their ships, while regulators are to review the companies. The regulators must ensure that these organizations have working systems and review them through their own audits. This makes the international and Norwegian safety management regulation a type of "co-regulation," because it demands cooperation between the companies and the reviewing institutions (Baram & Lindøe, 2013, p. 22). Such review can come under the name of control, audit, supervision, inspection, and vetting.

Norwegian vessels are supervised by the Maritime Authority to ensure that they comply with Norwegian regulation. These controls are called *flag state controls* because they are executed by the authority of the country where the vessel is registered (flagged). Norwegian vessels also undergo ISM audits every five years to ensure that they still meet the requirements of their ISM certificates, as ratified in the Norwegian regulation for safety management systems (Norwegian regulation on safety management systems for vessels, 2015). Some auditing of ISM, hull, machinery, load line, and vessels under construction are delegated to recognized organizations (see Section 2.2.2). During an audit, the inspector notes deviations from the regulations to which the ship owner must attend before obtaining a certificate or passing the inspection. If the ship owner fails to meet all requirements by a deadline, the Norwegian Maritime Authority can levy day fines or restrict the vessel in port. More about the Maritime Authority's auditing and the inspectors' considerations, see Gåseidnes (2014)

Foreign-registered vessels operating in Norwegian waters must also comply with Norwegian regulations (Norwegian Ship Safety and Security Act, 2007). These vessels are expected to be supervised and inspected by their flag state. For foreign-flagged vessels in Norwegian ports, the Maritime Authority is the port state authority. The Norwegian Maritime Authority inspects foreign vessels in Norwegian ports based on international *port state control* regulations (Paris MoU, 2015a). The port state controls the vessels' Maritime Labour Certificates and Declaration of Maritime Labour Compliance (IMO, 2017d; Maritime Labour Convention, 2013; Paris MoU, 2015a), but not ISM certificates or safety management systems. The comprehensiveness and frequency of inspections depend on a vessel's flag and history. Usually, they only briefly cover seafarers' contracts and physical working environment, with working conditions and daily life on board largely ignored (Sampson et al., 2014; Silos, Piniella, Monedero, & Walliser, 2012). Possible sanctions are detention and exclusion of the vessels, but this is onerous for inspectors and not favorable for trade relations, so such acts are kept to a minimum. It is common for vessels to be cited for at least some deficiencies during each inspection (Soma, 2004a).

2.2 Actors concerned with Norwegian coastal transport

In domestic maritime cargo and passenger transport, the most relevant actors are those pictured in Figure 2: international and national policymakers and governments behind safety regulation, regulators (RQ1), ship-owning company management (RQ2), and the operational personnel on vessels—the seafarers themselves (RQ3).

In addition, the Norwegian coastal maritime transport industry depends on a broad spectrum of actors who may influence the operating context directly or indirectly, such as contractors, investors, rescue organizations, insurance companies and clubs, banks, the media, and the public. There are many stakeholders involved in each vessel (see description in Soma (2004a)). For example, a vessel often has builders from one country, owners from another, is registered in another, managed from another, chartered from another, crewed by people from another, carrying cargo from another, insured in another, has a classification organization in yet another, and so on. These actors might be included as interest organizations and environmental stressors in Figure 2, but they are not studied in detail in this thesis because they are not parts of the chain of accident prevention under the ISM Code.

2.2.1 International authorities

Four international institutions are especially important for the safety regulation of the Norwegian coast: the IMO, ILO, EU, and Paris MoU.

The International Maritime Organization (IMO)

The IMO is the United Nations' specialized agency responsible for the safety and security of shipping and the prevention of marine pollution by ships. The IMO is a global standard-setting authority that seeks to create a fair, effective, and universal regulatory framework "so that ship operators cannot address their financial issues by simply cutting corners and compromising on safety, security and environmental performance" (IMO, 2017b). The IMO was founded in 1958, before which several international conventions had been developed, including the International Convention for the Safety of Life at Sea (SOLAS, 1914). When the IMO was established, it incorporated conventions like SOLAS. The IMO now has 171 member states and 3 associate members, in addition to the 64 intergovernmental organizations and 76 international non-governmental organizations that have consultative status to ensure information sharing and coordination in relevant matters. The IMO conventions are formulated in agreement by all participating members. They come into force through consensus by all 171 member states, but since the early 1970's a "tacit acceptance" procedure has ensured that a given state does not have to a convention explicitly; rather, it must object before a certain date if it is opposed to the convention. Generally, the regulations enter into force 18–24 months after formulation negotiations have finished. The IMO has no power to enforce conventions, except in vetting of certain training, examination, and certification procedures, so it is largely each ship's country of registration that is responsible for enforcing conventions. An IMO report states:

> IMO's regulatory work is a comprehensive body of international conventions, supported by literally hundreds of guidelines and recommendations that, between them, govern just about every facet of the shipping industry.… To a considerable extent, this success story of shipping in terms of its improving safety and environmental record can be attributed to the comprehensive framework of rules, regulations and standards developed over many years by IMO, through international collaboration among its Members and with full industry participation. (IMO, 2012b, p. 43)

ILO, EU, and Paris MoU

The International Labour Organization (ILO) is also significant for maritime safety. It was founded in 1919 and became the first specialized agency of the UN in 1946. It has a tripartite structure to ensure that the views of workers, employers, and governments are reflected in labor standards and policies (ILO, 2017). Policies are set by the annual International Labour Conference, to which each member state has two government delegates, an employer delegate and a worker delegate. All delegates have the right to express themselves and vote freely during the establishment of conventions. Member states can choose to ratify ILO conventions.

The European Union (EU) is increasingly important for Norwegian and international maritime safety policymaking because it can enact regulations that are directly binding on all member states (Norwegian Standing Committee on Business and Industry, 2006-2007). The EU is an economic and political partnership between 28 European countries. Norway is not in the EU, but as a member of the European Economic Area (EEA), Norway must adopt parts of EU regulations to enjoy free trade with the EU. All actions taken by the EU are founded on treaties that are negotiated, agreed to, and ratified by all EU member states (EU, 2013). The EEA countries (Iceland, Liechtenstein, and Norway) contribute to the formation of new, relevant regulations at an early stage. However, they have no representation in or formal opportunity to influence further decision making within the EU, although they are obliged to ratify EU conventions (EFTA, 2017). Norway has observer status in the EU's maritime safety agency (EMSA), but that agency only gives advice to the European Commission, which is the body that actually establishes regulations.

The Paris MoU on Port State Control has a central role in the enforcement of transnational regulation. It is an organization of 27 maritime administrations in Canada and Europe (including Russia) that seeks to eliminate "sub-standard ships through a harmonized system of port State control" (Paris MoU, 2017). The Paris MoU organization also trains and authorizes officers who monitor ships in European and Canadian ports in port state controls and determines the exact nature of compliance with international conventions.

Table 3: About the Norwegian Maritime Authority

	Norwegian Maritime Authority *Source: Maritime Authority (2017) and ministries' webpages*
Employees	307
Tasks	Supervision of the industry: Controls Norwegian vessels according to national regulations and foreign vessels in Norwegian ports according to international regulations. Assures that Norwegian ship owners maintain high safety and environmental standards and employ seafarers with good qualifications while providing good working and living conditions. Manages the Norwegian ship registers. Contributes to formulation of regulations.
Main objective	The preferred maritime administration
Owner(s)	The Ministry of Trade, Industry and Fisheries (responsible for designating industrial and seafood policy to maximize value creation in the Norwegian economy) and The Ministry of Climate and Environment (responsible for carrying out environmental policies).

2.2.2 National government and maritime regulators

The section describes the roles of Norwegian maritime regulators, together with the political structures to which they are subordinate, and other organizations that have been granted

supervisory authority. Norway has two official maritime regulators, but only the Maritime Authority enforces the ISM Code and is thus the regulator in focus in this thesis (see Table 3).

The Norwegian Maritime Authority

The Norwegian Maritime Authority controls that ship owners maintain the safety of seafarers, material values, and the environment. Their "activities are governed by national and international regulation, agreements and political decisions" (Maritime Authority, 2017). Most of the authority's tasks have been stable over the years, formally specified by each successive government. Additional political instructions are given in an annual mandate letter from the political authorities, and supplementary influence can be exercised at any time.

The Maritime Authority's functions are to serve as an adviser that provides guidance to their customers and government, be a driving force for safety and the Norwegian flag, act as a supervisory authority through certification and control of vessels, and participate in the development of national and international regulations (Maritime Authority, 2017).

The overall objective of the Maritime Authority is to be *the preferred maritime administration* and "offer competitive services so that the industry chooses the Norwegian flag" (Maritime Authority, 2017). They are instructed by the responsible ministries with additional goals of costumer orientation, visibility, and "to work for safety for life, health and environment and material values" (Norwegian Ministry of Trade Industry and Fisheries, 2017, p. 3).

The three secondary goals are divided into sub-targets with performance indicators (Norwegian Ministry of Trade Industry and Fisheries, 2016, 2017) that resonate with the Maritime Authority's self-descriptions about being heard internationally, cooperating with research and training institutions, yards, and designers, and facilitating good tripartite cooperation with employee and employer associations (Maritime Authority, 2017). Maritime Authority representatives participate in the arenas of the international actors described in last section, among others. They also carry out awareness campaigns, distribute information in various forms, and engage in dialogue with industry, media, government and other actors, such as facilitating tripartite collaboration in workshops and hearings during regulation development. They also arrange a successful annual safety conference for stakeholders.

Governmental politics

The Norwegian government is deeply concerned with facilitating maritime trade and industry (Norwegian Ministry of Trade Industry and Fisheries, 2015). Other countries like Brazil and the USA have more protective regulations, but Norwegian politics favor opening up the transnational flow of trade (see Article A for more details).

The government also wants to use the maritime industry to help reach its climate goals. All Norwegian governments over the last decade have aimed at moving more transport from road to sea because it reduces road traffic and unwanted emissions (Norwegian Cabinet, 2005, 2009, 2013). The coastal fleet will have to bear most of this transfer, but most of its bulk and general cargo vessels are old and not very environmentally friendly. New vessels are not common because of coastal transport's low profitability. A condemnation scheme is not considered feasible because it still would not make it cost efficient to invest in new vessels

(Norwegian Ministry of Trade Industry and Fisheries, 2015). Nevertheless, environmental friendliness and innovation are being emphasized as a competitive advantage for the Norwegian maritime industry in its current official *maritime strategy* (ibid).

Delegated authority: Recognized organizations

Ship owners, vessels, and seafarers need to be classified and certified according to multiple regulations. Much classification and certification are delegated to private *recognized organizations*, which are included in the International Convention for the Safety of Life at Sea (IMO, 2017a). In Norway, classification and certification authority is delegated to recognized organizations by the Ministry of Trade, Industry and Fisheries. They are given the authority to inspect vessels according to technical regulations or to conduct ISM audits and revisions. They carry out inspections according to national regulations and use their own requirements, which have been developed to ensure that inspection and certification are standardized. The recognized organizations determine ship owners' rule compliance based on regulations assembled in the RO Code (RO Code, 2013).

Several organizations have such authority, and ship owners can contract for this service from any authorized organization. Recognized organizations are also called classification societies or consultancies. Well-known large classification societies include DNV GL, Lloyd's Register, and the American Bureau of Shipping, but there are also small one-person companies who deal with some regulations. Recognized organizations assess certain aspects differently, so ship owners are known to prefer organizations that go easy on their weaknesses (Silos, Piniella, Monedero, & Walliser, 2013). In an effort to standardize recognized organizations, their performance is ranked internationally (Paris MoU, 2015b), and the Maritime Authority audits them and participates in some of their revisions (Norwegian Ministry of Trade Industry and Fisheries, 2016).

Table 4: Norwegian-controlled international and coastal passenger and cargo numbers, from the latest reported year

	Passenger transportation	Cargo transportation
Sources: Norwegian Ministry of Trade Industry and Fisheries (2015); Statistics Norway (2017a, 2017b, 2017c, 2017d, 2017e).		
Ship owner companies	413	1,241
Vessels in Norwegian registry (NOR) with coastal and international activity	1,225 ferries, high-speed catamarans, doctor coaches, etc.	1,228 general cargo, tank, bulk, supply vessels, live fish carriers, etc.
Coastal vessels in Norwegian registers, approximate number[2]	350	500
Employees	9,379	15,509 (excluding employees on foreign-registered vessels)
Port calls in Norwegian ports by Norwegian-owned vessels	9,630 (26 by vessels registered abroad)	19,832 (8,544 by vessels registered abroad)
Passengers or cargo, water transport	53 million passengers	78 million tons of cargo
Turnover – domestic transport	461,672,755 US dollars	467,663,606 US dollars

[2] Numbers estimated by the Norwegian Ministry of Trade Industry and Fisheries (2015). It is difficult to obtain a reliable number of how many foreign vessels operate on the Norwegian coast, even though many researchers have suggested methods on how to obtain an overview (Kongsvik, Bye, Almklov, & Kleiven, 2016).

2.2.3 The industry: Companies, vessels, and operational personnel

This section offers an overview of Norway's coastal cargo and passenger sectors, how vessels and work are organized, and key accident statistics. Table 4 presents key Norwegian passenger and cargo transport numbers.

Fleet and flags

Norwegian investors own one of the largest maritime fleets in the world (IMO, 2012b). Some vessels are involved in fishing or support operations in the oil industry, aquaculture, or other activities, but most transport cargo or passengers. Many Norwegian-controlled vessels operate primarily on the high seas or between foreign ports. The ones with a focus on ports along the Norwegian coast are called the coastal or short sea transport fleet.

On board, every task depends heavily on other tasks. Each crewmember is essential, especially on Norwegian vessels, where manning is low. In addition, logistics are tightly *coupled* (a term from Perrow (1999), since each ship has its own course or a plan and must be in place and on time to avoid collisions or delays in their logistical chain. There are often cargo or passenger connections with other transport forms, and terminal personnel and other personnel work on tight schedules.

Competition between different transport forms and within sea transport is immense. Increased cost efficiency in more rapid air and ground transport modes has forced sea transporters to compete largely on price. The ability to register vessels in low-cost countries far from their actual operation has also heightened competition within sea transport, leading companies to be deeply concerned with costs.

Ship owners are free to register their vessels in the flag state they prefer. The reasons to flag a vessel in a country far from its operation include lower taxes, fewer regulatory demands, and lesser prohibitions (Kristiansen, 2013). Some states have low fees and do not enforce international regulations, allowing ship owners to register low-standard vessels and save on manning costs thanks to weak labor rights (Bhattacharya (2012); International Transport Workers' Federation (2016)). Such vessel registers have been called *flags of convenience*. On the opposite side of the scale, Norway is in the top five ship registers (Maritime Authority, 2016, p. 19).[3] However, if a company operating in Norway registers a vessel in another country, it will be registered under a flag of convenience, a process called *flagging out*. All vessels in this study are registered in Norway (NOR) and adhere to the ISM Code.

[3] In Norway, the NOR register is used for companies with management in Norway and vessels following Norwegian regulation (Maritime Authority, 2015d). This includes Norwegian manning. Flagging out is often a more affordable alternative for the ship owner. The Norwegian International Ship (NIS) register has been established to compete with flags of convenience. NIS is open to foreign-controlled vessels that follow international regulation, in which the crew's nationality is unspecified so they can be paid under the home country's labor regulations (Maritime Authority, 2015c). Before January 1, 2016, NIS vessels could not ply their trade between Norwegian ports. In 2016, the NIS register was opened to ships operating between Norwegian ports, so some ship owners have "flagged home" their vessels to the NIS.

Text box 2: Support organizations

Unions strive to influence political decision makers to ensure their preferred framework conditions.

Employer organizations protect members' interests, improve the industry's economic and social conditions, and play an active role in industry concerns.

The Norwegian Ship Owners' Association represents about 160 ship owners controlling 1,800 vessels in tanker and bulk transport. **The Association of Cargo Freighters** represents smaller Norwegian ship owners who operate approximately 300 cargo vessels in total.

Employee organizations work to secure safe wage and working conditions for seafarers, both in Norway and abroad. **The Norwegian Seafarers' Union** represents around 100,000 seafarers working on Norwegian and foreign vessels around the world, and **The Norwegian Association of Engineers** represents approximately 6,000 members. **The Norwegian Association of Maritime Officers** represents roughly 8,000 maritime leaders, such as captains and mates, on all types of ships in Norway and abroad.

Essentials about the passenger sector

Passenger vessels include ferries, cruise ships, charter boats, and high-speed crafts. The data concerned passenger vessels in this thesis is mainly from high-speed crafts. Most Norwegian passenger vessels are licensed to carry passengers—and some cargo—on fixed routes or for more flexible chartering purposes like tourism. *Cruise ships* run a longitudinally coastal transport route; *ferries* are used over short fjord passages, while *high-speed craft* are most common on other coastal voyages and for chartering.

The high-speed passenger vessels that operate on Norwegian coastal routes are privately owned, but their service is contracted by Norwegian counties through competitive tendering based on Norwegian competition law and EU regulations, which require the least costly vendor to be selected if other criteria are found to be equal (Norwegian regulation about public procurement, 2006). Often, counties add certain technical and sustainability criteria for the vessels and companies; otherwise, they expect the companies to satisfy all relevant regulations (Gullestad, 2013). In practice, the least expensive bid that fulfils the criteria always wins, making it unlikely that it will include any extras like safety measures beyond regulatory requirements. Indeed, the successful bidder is more likely to be an organization that meets the minimum legal requirements and maximizes cost savings.

Essentials about the cargo sector

Competition is less regulated in the cargo sector, and the activities are more diverse than in passenger transportation. Cargo vessels—general cargo and bulk vessels—are commonly divided into subgroups of vessel types operating in different markets and industries (Statistics Norway, 2015). General cargo vessels include pallet, container, RORO vessels, and vehicle carriers, while bulk vessels include tankers, chemical, food, cement, sand, and live fish carriers. Tankers and live fish carriers stand out from dry-bulk vessels; the latter operate in markets with low demand and low rates, while oil and gas tankers and live fish carriers usually involve higher demand and prices. Most coastal cargo vessels have long-term contracts or routes, while some take one job at a time on short-term (voyage/spot) charters.

Organizations or people hiring a cargo vessel are called charterers; they can be oil companies, governmental construction companies, public cargo handlers, or manufacturers, among others. The charterer contacts—directly or through a shipbroker—ship owners that can meet their needs. Sampson et al. (2014) offer descriptions of international ownership structures

and charterers' potential influence on safety on the vessels. In Norwegian coastal cargo, chartering and ownership are generally simpler organized.

Ship owner companies

The work is organized quite similarly for passenger and cargo transport at most Norwegian coastal ship companies (see Figure 3). Most companies own their own ships, employ the crews, and operate in particular local areas.

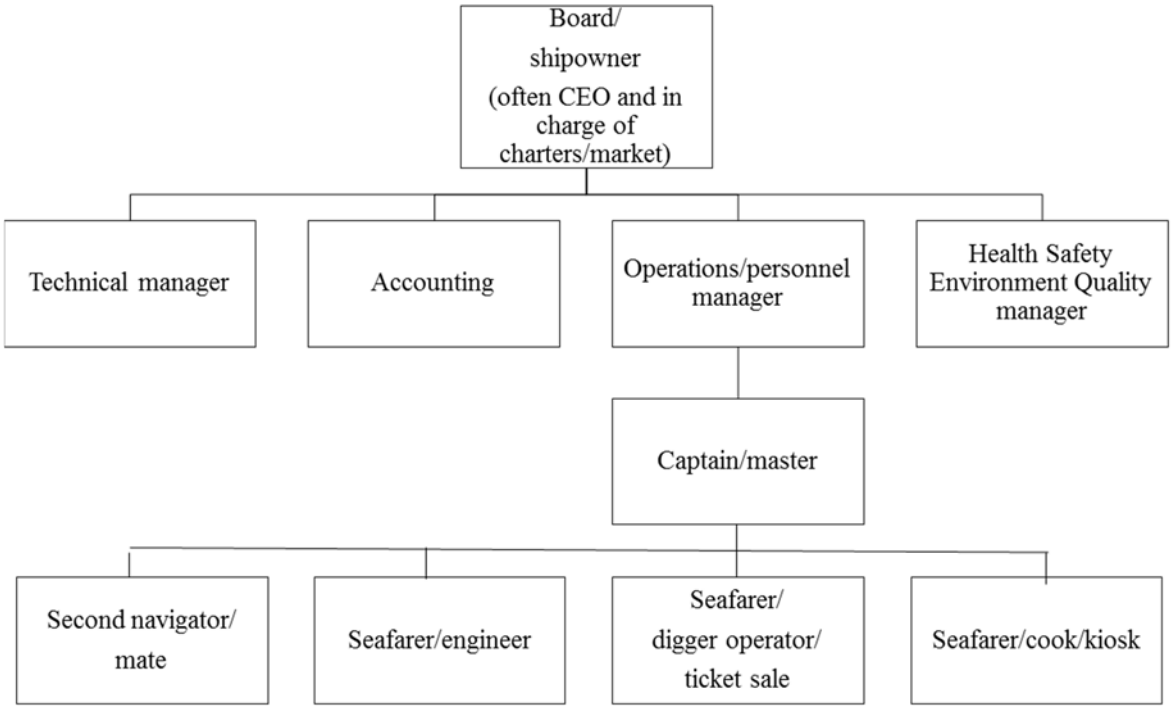

Figure 3: Common organizational structure of a Norwegian coastal ship owner office and vessel(s)

Ship owner offices provide service management, operations management, and support. Responsibilities include safety management systems, contracts and budgets, salaries and bills, booking of maintenance and shipyard time, provisions and needed equipment, and supervision of regulations and certificates.

The number of employees performing these functions varies significantly. Some ship owner offices consist of a management team of several employees; this is often the case with passenger transport companies running high-speed craft. Smaller offices are more common in the cargo sector. They can have part-time employees hired by a ship owner or perhaps an accounting clerk. Small offices usually contract for most of their services from other companies or consultants, especially for ISM-related tasks.

All companies must have one designated person who has access to the highest levels of the company and is responsible for safety issues and pollution prevention on each vessel, including ensuring that adequate resources are provided; however, this designated person can be an outsourced contractor (ISM Code, § 4, see Appendix I).

On board

The ship captain (or skipper or master) is usually the link between the vessel and the office. The captain is responsible for the crew, the ship, and its cargo (Norwegian Maritime Code, 1994). He or she is a skilled and certified navigator and is always in charge in an emergency situation. On coastal vessels with limited manning, there are often one or two navigators (a captain and sometimes a chief officer/mate), an engineer or combined engine operator/seafarer, and one or more seafarers.

Whether the manning includes a full-fledged engineer or an engine operator with less education and training depends on the vessel's engine certificate. This person is responsible for running, logging, and maintaining the engine and related equipment, often all the mechanical and electrical equipment on board for which he or she is certified. Other maintenance or technically advanced tasks are carried out by onshore electricians when the vessel is docked. The rest of the crew, known as seafarers or sailors, consists largely of able-bodied seamen with or without formal education. Typical seafarer tasks are mooring, loading, discharging, maintenance, cleaning, and lookout duty. They deal with manual transport item handling and control. On coastal vessels, most seafarers also have additional tasks such as cooking, crane/digger driving, and kiosk work or ticket sales. In this thesis, the term seafarers is used for the entire crew.

A major difference between passenger and cargo vessels is the time crews spend onboard. On Norwegian coastal cargo vessels, crews usually live on board for four weeks. Some work according to watch-keeping schedules, often of six hours on and six hours off. The crew may not be large enough to split into watches, in which case seafarers work when operations require and rest when possible. Navigators typically work when their skills are needed and have administrative and coordination tasks; sometimes, they help with loading and discharging. After four weeks on board, the crew goes home for about four weeks.

In high-speed passenger vessels, however, it is common to work on board in the daytime and sleep ashore at night, whether at home or in locations with the rest of the crew. Specific schedules vary between vessels and companies. In the coastal passenger sector, the crews also have working periods of several days or weeks, before they go off duty for some time.

Each crew member's skills are highly valuable because manning is limited and vessels are specialized. Transport vessels differ in construction, bridge design, engine technicalities, routes, operations, and so on, and therefore require experienced and stable personnel (Rosness et al. (2016).

Accident statistics

Maritime accident statistics can always be debated, since it is difficult to report, calculate, and normalize the number and size of accidents, injuries, vessels, ports, cargo, and the like (Kongsvik, Bye, et al., 2016). Internationally, the number of large ship accidents and individual injuries on ships appears to have decreased in recent decades (AGCS, 2015, 2016; IMO, 2012a; Seafarers' rights, 2016). There were an estimated 600 deaths worldwide in 2013 (Maritime Bulletin, 2014) among roughly 1,300,000 seafarers (IMO, 2012). However, the international

numbers only include injuries and accidents involving large vessels, which are involved in few accidents: in the entire North Sea in 2015, only four such ships were lost (AGCS, 2016).

On Norwegian vessels in 2004–2013, there were an average of 15 killed and 424 injured annually (Nævestad, Phillips, Elvebakk, Bye, & Antonsen, 2015). Updated local statistics on Norwegian waters show divergent trends: *personal injuries* have decreased considerably at the same time as *ship accidents* have increased (Maritime Authority, 2015a, 2015b, 2016). The same trend is evident in both cargo and passenger transport operating along the Norwegian coast (see Figure 4). Personal injury statistics include injuries that caused 72 hours or more of sick leave (Maritime Authority, 2015b), often because of clamps, cuts, chemical injuries, falls, or burning during loading, discharging, cooking, provisioning, mooring, and maintenance. Ship accidents involve damage to or loss of vessels, most frequently related to groundings, collisions with docks and bridges, fires, and engine breakdowns. Ship accident investigations generally establish that the navigation was disrupted before the accident, due to technical error or the navigator being inattentive or asleep.

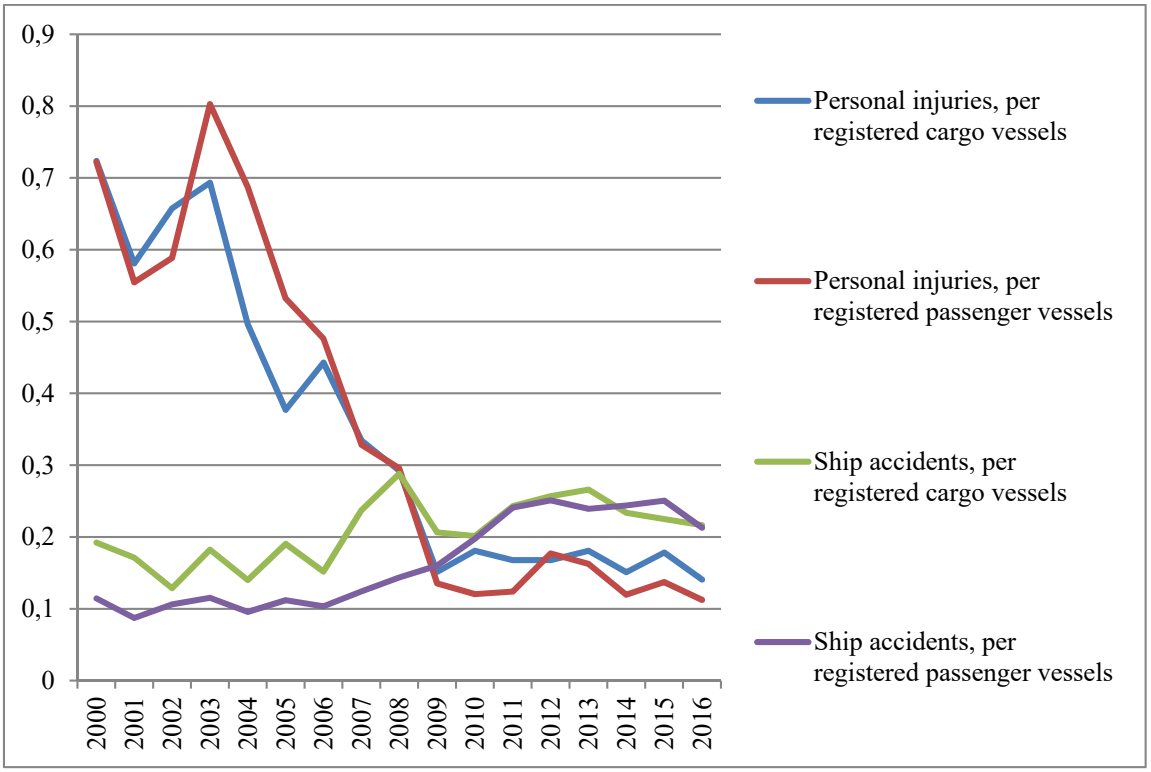

Figure 4: Number of ship accidents and personal injuries for Norwegian cargo and passenger vessels along the Norwegian coast, 2000–2016, divided by number of NOR-registered vessels for each vessel type: diverging trends

3 Core terms: Does safety trickle down from regulation?

The core terms used in this study are described in this chapter. The definitions are based on conventional safety, decision making, regulation, and accountability theories. In addition, institutional theory offers an understanding of how safety, decision making, regulation, accountability, and the like are notions that get translated as they travel between actors and across levels (see text box 3, next page).

The theoretical foundation is that safety at work depends on decision making by several actors on different levels (see Section 3.1). The departure point is Figure 5 (J. Rasmussen, 1997), which shows government, regulator, management, and staff levels. Based on the literature, I define the term safety-related decision making in Section 3.1.4. Regulation as a means to achieve safety is an important premise for this thesis, so regulation and related terms are elucidated in Section 3.2. Accountability requirements, among other issues, are interwoven into today's functional regulation.

In Chapter 4, the core terms introduced are combined, and relevant research about safety regulation and decision making on the political, administrative, management, and operational levels is presented. The literature reviewed in Chapters 3 and 4 will, together with the information about the Norwegian coastal transport industry (Chapter 2), lay the groundwork for the development of the research questions in Chapter 4.

3.1 Safety and decision making

The basic theoretical terms of this thesis are outlined in this section.

3.1.1 Safety as a core concept

While safe actions have always been carried out, safety as a theoretical concept is relatively new. Having undergone rapid development over the last 150 years, safety is a central idea in most societies today (Aldrich, 2010; Amalberti, 2013; Guarnieri, 1992; Røvik, 2007). The idea of safety developed with safety practices (Gherardi & Nicolini, 2000) and a safety-conscious culture (Abrahamson, 2011). Still, what safety is and what to protect is continuously evolving and being translated and transformed.

Safety can be understood both as the *absence* of risk and the *presence* of organizational factors leading to sound operations (Kongsvik, 2013). Risk can also be defined in many ways, often as a product of probability and consequence (Rausand & Utne, 2011). It is usually recognized in both safety perspectives that there will be some risk in work organizations, but appropriate measures can reduce risk or increase safety.

Text box 3: Organizational theory: Ideas and trends

Organizational ideas describe an organization's ideal nature. Cost efficiency is a material idea. Legitimacy is an immaterial idea; successful organizations must appear in line with society's and customers' values (Kongsvik, 2006; Røvik, 1998). To realize the idea of legitimacy, an organization can show that it is safe and accountable, as, for example, by having documented safety management systems.

Ideas are transformable rather than fixed; general and abstract ideas may be concretized, mixed with local traditions, and sometimes shaped into management tools (Røvik, 2011, p. 642). An idea can travel through all kinds of actors and change along the way (Czarniawska & Sevón, 1996; Røvik, 2007).

Actors each have their own associations of the idea and *translate* it according to their views and needs (Czarniawska & Sevón, 1996; Latour, 1987). Organizational ideas spread between organizations through regulation and in arenas where organizational challenges are discussed (Røvik, 2007).

When an idea is legitimized as a model on how to organize, it becomes institutionalized (Røvik, 2007); it is no longer necessarily seen as a socially created product, but as a rule-like fact and simply the right way to do things (Røvik, 1998, p. 19).

Organizations will be more alike when they follow the same set of regulations, which is known as forced isomorphism, when they resemble successful organizations (mimetic isomorphism), or when they take advice from people with the same norms and perspectives (isomorphism due to normative pressure) (DiMaggio & Powell, 1983).

Many safety approaches have been adopted, replicated, and institutionalized, but some also have been short-lasting fashions that have gone dormant relatively quickly (Bort & Kieser, 2011; Røvik, 2007, 2011).

In this thesis, the core understanding of safety is that operations are carried out without accidents or harm over the short and long terms (Dekker, 2002). Organizational factors must be present to *control activities* "to avoid accidental side effects causing harm to people, environment, or investment" (J. Rasmussen, 1997, p. 184). The personnel must strive to control activities on all levels. Operators need the resources and room to work according to plan, prevent accidents, and handle unforeseen developments. This means handling all types of risk.

The sociological aspect is important in the current view of safety. Safety depends not only on resources or technical structures, but also on *social processes.* Social interaction leads to knowledge about and actions undertaken to prevent loss. It can be viewed from a micro, meso, or macro level and emphasize different perspectives. Vaughan (1997), for example, shows how safety is part of an organization's (or a society's) structure and culture through risk assessments, informal work practices, and so on. She also describes sociologically how changes in safety management or practices alter the structures and culture in an organization. For example, there is typically more regulation or resources after accidents, and practical drift when there are few accidents. This indicates that actors on different levels influence one another's safety.

What is considered the right mix to achieve a goal like safety varies over time, in line with a society's values (Abrahamson, 1996, 2011; Røvik, 2007). In the last century, safety prescriptions were transformed from psychological and economic to sociological, technological, and organizational studies (Kjellén & Hovden, 1993; Le Coze, 2013; Rosness et al., 2010). Currently, one usually tries to include all fields. The perspective is systemic (Hollnagel, 2002), with all organizational and environmental aspects regarded as potential hazards or protections against accidents. Interactions and dependencies within the entire system can and will cause accidents (Hollnagel, 2002).

Several research approaches fit within this systemic frame, such as *normal accident theory*, *high*

reliability organizations, and *resilience engineering* (Rosness et al., 2010)*:* Safety depends on the dynamics in the system. Variability in the system is natural and can be both positive and negative. Human actions are also variable and can either lead to accidents or increase safety. Personnel constitute an essential part of the system on all levels; humans are needed to create a system, maintain it, use it, and inspect it. The theory of *resilience engineering* (Hollnagel, Woods, & Leveson, 2006) elaborates how an organization should be able to identify and act upon both positive and negative variability, develop the staff, and prevent accidents. The resilience engineering framework refers to four abilities that an organization must have to handle variability in its operations: responding, monitoring, learning, and anticipating (Hollnagel, 2011; Hollnagel, Nemeth, & Dekker, 2008; Hollnagel et al., 2006). Resilience and safety are achieved when the organization can adjust successfully to changing circumstances (Rosness et al., 2010). It is essential that personnel are able to adapt to any situation (Hollnagel, 2011), which invokes the terms operational dynamic adaption (J. Rasmussen, 1997) and bandwidth management.[4]

3.1.2 Safety depends on several actors

Working within an operational context means being influenced by other people's actions. Personnel face conditions that are intentionally or unintentionally created by others in the organization or the surroundings. These environmental conditions affect how safely work can be done by influencing discretionary space, cooperation, incentives, power, communication, and decision making on all levels (Rosness, 2009; Rosness et al., 2012).

The chain of safety management

Several societal and organizational levels influence safety: politicians, regulators, company management, and operational personnel, not to mention environmental stressors. Figure 5 shows how safety management can trickle down from the upper to the lower levels even while environmental stressors influence how the risk of accidents can be controlled on all levels (J. Rasmussen, 1997; Rosness et al., 2012). Figure 5 illustrates the many levels needed to control safety, the pressure they face from outside factors like the political climate and market conditions, and the many research disciplines needed to study safety and risk prevention. Engineering is relevant when studying work, while decision theory and organizational sociology are relevant to studying the company level, according to J. Rasmussen (1997). The levels are presented in detail in Chapter 4.

Dekker (2006, p. 59) highlights the terms *blunt end* and *sharp end*: the sharp end consists of personnel in direct contact with safety-critical processes, while the blunt end is the part of the organization (or set of organizations) that supports and drives the activities that take place at the sharp end. The blunt end provides both resources to and constraints and pressures on the sharp-end personnel. In the context of this thesis, the sharp end consists of operational personnel like seafarers, while the blunt end includes regulators, administrators, and management who "control the resources, constraints, and multiple incentives and demands that sharp-end

[4] For more about bandwidth management, see especially the works of Paul Schulman and Emery Roe (such as E. Roe & Schu lman, 2008; Schulman & Roe, 2011; Schulman, Roe, Eeten, & Bruijne, 2004).

practitioners must integrate and balance" (Woods, 2010, pp. 1, 8). It is common to assume that each responsible level will take risk prevention seriously (Dekker, 2012), even though this is sometimes up for debate, as during budget negotiations.

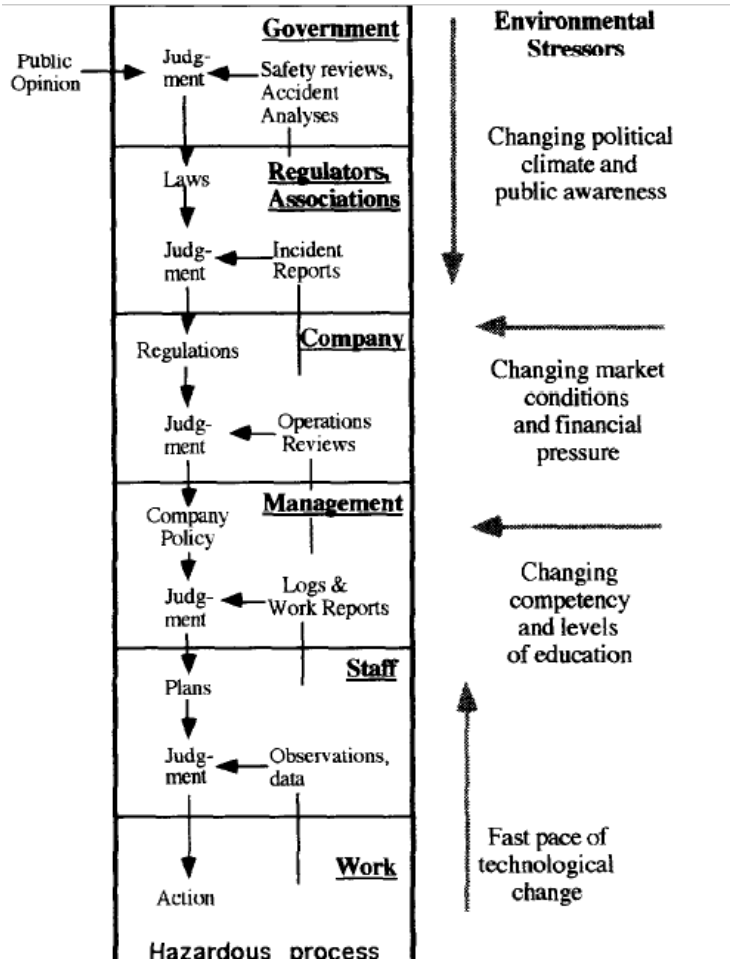

Figure 5: The socio-technical system involved in risk management of hazardous processes (J. Rasmussen, 1997, p. 185)

The model illustrates the general need for cooperation between levels. The actors depend on each other for several reasons, as the next section shows.

Trust and blame

A balanced level of contact between levels can be a basis for good cooperation (Reason, 1997). Further, trust consists of expectations about others' actions (Jeffcott, Pidgeon, Weyman, & Walls, 2006; Julsrud, 2008; etc.). Trust between regulators and organizations is important to complete tasks, especially in regulating safety (Bratspies, 2009; Dekker, 2012). For instance, regulators must have open lines of communication with industry to obtain correct, truthful information about an organization or the industry as a whole (Dekker, 2012, p. 12). This forces regulators to rely on companies and their goodwill. The companies, in turn, depend on the regulators to obtain crucial resources like permissions and environmental approvals. Vaughan's (1997) analysis of the *Challenger* space shuttle launch displays clearly how vital all types of resources and contact from government and management is to the personnel and the quality of

the outcome. This and many other studies emphasize that subordinate levels depend on sufficient resources and support from upper levels to be able to set the right priorities and do their work safely (Perrow (1983); Rosness et al. (2012); Tjørhom (2010), among others). Resources can include manning, equipment, leadership, guidance, regulations, time, rest, and other structures and support. It also can mean care and concern, making it doubly linked with trust (Jeffcott et al., 2006).

Usually the operational, managerial, and regulatory levels hold different opinions of a issue or solution (Hollnagel, 2009; J. Rasmussen, 1997; Reason, 1997; Rosness, 2009; Rosness, Blakstad, & Forseth, 2011; Rosness et al., 2012; Vaughan, 1997). When their expectations are not met, actors often blame other levels for things they believe the others should or should not have done (Hood, 2007, 2011). Blame is especially common after scandals and accidents. Jeffcott et al. (2006) found that blame was a daily part of railway operations. Power is closely connected to the distribution of resources, to the cooperation between levels and actors, and therefore to safety.

3.1.3 Safety practice involves decision making

To work safely, each actor –working in an organizational context – needs to make several decisions that depends on the decision making of surrounding actors. Informed decision making can be essential to avoiding accidental side effects, actions, or events with consequences that negatively affect something that people value (Rosness, 2009), such as personnel, products, or the environment. The literature about decisions and decision making definitions is presented and the research about safety and decisions on different levels is discussed in Chapter 4.

Decisions

Most workplaces are organized around decisions, which can also be viewed as commitments to action (Halvorsen, 2015, p. 28; Lipshitz, Klein, Orasanu, & Salas, 2001). A decision has different characteristics depending on the setting in which it is made.

In strategic meetings, decisions are clear and documented; they usually occur at the company and management levels. Reason (1990) uses the term *decisions* primarily for high-level judgments, which can be precursors for safe or unsafe acts at the lower levels of an organization. For high-level decisions, Kongsvik et al. (2015, p. 88) distinguish between *strategic, long-term decisions*, with months and years elapsing between decision and action, and *operational decisions* that involve coordination and planning for the next few days and weeks.

During normal dynamic work, decisions can be more difficult to spot. Kongsvik et al. (2015) define *instantaneous decisions* as those made by sharp-end personnel during the performance of tasks. In these settings, an actor or group of actors might not deliberately make a conscious decision or even agree that a decision was made at all (March, 1994; J. Rasmussen, 1997; Rosness, 2009). However, an observer can identify a point in time at which a decision must have been made, because that observer can think of alternative choices that the actor(s) could have made. To become aware of which decisions have led to action and to understand what has occurred, observers seek to find the moments at which an actor could have acted out

other alternatives. In such situations, it is often difficult to separate the decision from the decision-making process.[5] Therefore, researchers are advised against trying to isolate the decision or the decision-making process; rather, they are encouraged to determine what aspects were important for the actors during the decision-making process (Rosness, 2009, pp. 807-808).

Decision-making modes

Decision making at work is often a collective activity that can develop over shorter or longer periods of time, be more or less intentional, and be constrained and shaped by both context and individual qualities (Rosness, 2009, p. 807). Decision making can even be seen as action adapted to situational constraints (Rosness, 2009, p. 812).[6]

Limited rationality behind decisions

Since the nineteenth century, theories on decision making have been anchored in rational choice theory, which holds that decision makers have all relevant information and the time to categorize data, foresee outcomes, and make the optimal decision based on a consideration of all relevant aspects (Dekker, 2017a; Lipshitz et al., 2001): "Errors were attributed either to irrationality or to unawareness" (Reason, 1990, pp. 36-37).

Bounded decision theory gained popularity in the second half of the twentieth century; it holds that most decision making is part of complex social processes and includes more aspects than any one actor can be aware of (March, 1994). Many things happen at once, situations are ambiguous, and the actors must interpret all these inputs based on their own values and the information available to them (March, 1994). When the problem of limited time is added to such a complex environment, the decision-making process is far from the ideal suggested by rational choice theory. Agents tend to act upon beliefs or rituals, change meanings, or appear to say one thing and do another (March, 1994). Still, decisions are locally rational and make sense when one knows the actor's values, information, and awareness at the time of decision making (Dekker, 2017a). Sociologist Max Weber (1864–1920) had already underlined the importance of every actor's meaning, understanding, and values in social action (Månson, 1996b). Weber held that actors always make decisions that make sense to them in their situation and with the information and values they have.

Some realistic decision-making modes

Numerous studies in recent decades have demonstrated that decisions are commonly made even though "not all alternatives are known, not all consequences are considered and not all preferences are taken into consideration" (Kongsvik et al., 2015, p. 87). Reason (1990, p. 38) notes that "human beings, even when engaged in important decisions, do not work out detailed future scenarios"; rather, the decision maker is likely to contemplate only a few alternatives and neglect seemingly obvious ones. Herbert A. Simon coined the term *satisficing* to describe such

[5] Reason (1990) discusses actions with or without prior intentions, such as hostile actions, slips, lapses, and mistakes. I do not examine these further here, since this thesis concerns criteria for and constraints on decision making, rather than characterizing whether a given decision was wrong and what type of error it was.
[6] For a fuller review of individual and collective decision making with perspectives from the social sciences, see, for example, Halvorsen (2015) and Kongsvik et al. (2015).

decision making, in which actors try to find a solution that meets certain criteria and is good enough (March, 1994).

In most operational settings, there are concrete demands to solve the actual problem, although decisions must be reached under complex conditions with time pressures and ill-defined goals (Lipshitz et al., 2001). Klein (1993) uses the term *naturalistic decision making* to describe his studies of firefighters' work performance. He called experienced personnel's decisions *recognition-primed decision making*. Their collective decisions are not separated from the rest of their work, and they have no or at best limited time to discuss and debate criteria, alternatives, constraints, and pros and cons. Rather, their decisions are made through a silent understanding of the situation, comparisons with other situations, and relying on decisions that have worked earlier under similar conditions. If problems are foreseen, then a given option might be modified or rejected and another typical reaction tacitly explored.

Recognition-primed decision making corresponds with a mix of Rasmussen's (1986, pp. 100-103; 1997) skill-based, rule-based, and sometimes knowledge-based problem solving. In the skill-based mode, the actor decides according to patterns of preprogrammed instructions, while in the rule-based mode the actor solves familiar problems with rules of thumb. It can save time to use predictable reactions rather than considering all alternatives. Rasmussen stresses that:

> Actors are immersed in the work context for extended periods; they know by heart the normal flow of activities and the action alternatives available. During familiar situations, therefore, knowledge-based, analytical reasoning and planning is replaced by a simple skill- and rule-based choice among familiar action alternatives, that is, on practice and know-how. When, in such situations, operational decisions are taken, they will not be based on rational situation analysis, only on the information which, in the running context, is necessary to distinguish among the perceived alternatives for action. (J. Rasmussen, 1997, pp. 187-188)

When there is a need for more thorough consideration of alternatives, the actor employs the analytic and conscious knowledge-based decision-mode. Here the reasoning can be abductive, like the method of this thesis (see Section 5.1) and as Kenneth Pettersen analyses in aviation:

> When maintenance technicians adjust their actions to the contingencies of different situations they interpret a set of different clues to decide on which actions should be taken next. This process is very similar to that of scientists interpreting experimental results to evaluate a hypothesis. As in any scientific enquiry, cultural and experiential knowledge is required when the maintenance technicians interpret the significance of evidence before actions are taken. (K. A. Pettersen, 2013, p. 110)

Decision making within a discretionary space

In this thesis, I combine actor-oriented and structure-oriented social theory to find the space between structures in which actors can make their own decisions. This is inspired by the founders of sociology, especially Weber's focus on the actors' own meaning and understanding (Månson, 1996b), but also how Karl Marx (lived 1818–1883) viewed people's actions as resulting from the structures into which they are born (Månson, 1996a).

Decision making is context- and activity-specific (Halvorsen, 2015; J. Rasmussen, 1997; Rosness, 2009). In organizations, the context is shaped by culture, structure, interactions

and relations, and technology (Schiefloe, 2003; Schiefloe & Vikland, 2006). The culture is comprised of norms, values, and competences that constitute conventions for behavior, interaction, and communication (for example Antonsen, 2009a). Structure includes elements like rules and tasks. Interactional dynamics are differently expressed in different situations and activities (Halvorsen, 2015, p. 50), while technology in the context of this thesis includes vessels and other work equipment. The organizational factors are influenced by the environment and society as a whole, and all these aspects influence and are influenced by one another, making it vital to take into account the complexities and indeterminacies of the context when studying decision making at work (Halvorsen, 2015, p. 28; March, 1994; J. Rasmussen, 1997; Rosness, 2009).

In practice, others' decisions affect each actor's ability to make a decision. Some decisions are more critical for one actor than for others. Decisions about procedures, responsibility, time required to complete a task, questions, parallel or competing operations, or other intervening elements will affect any actor's decision making. Antonsen (2009a, p. 1120) describes the various aspects that contribute to an accident, concluding that all "these contributing factors are *decisions* that involve the evaluation of risk, the sorting of information, and a trade-off between different interests." How an actor adapts to a situation, can be crucial, even a matter of life and death (Rosness (2009).

Within the context is a space where the decision maker has the freedom to choose between action alternatives. He or she needs a certain space to choose how to work safely according to plan, anticipate what can prevent accidents, and handle the unforeseen (Hollnagel, 2009; Hollnagel et al., 2006; Reason, 1997). J. Rasmussen (1997) emphasizes the need for a *space of possibilities*, with degrees of freedom that make it possible for personnel to perform tasks according to their own preferences. Dekker (2012, p. 81) uses the term *discretionary space*, which is "filled with ambiguity, uncertainty, and moral choices." An organization should be clear about the borders for each actor's discretionary space, since responsibility without space and authority to make decisions creates unfair double binds (Dekker, 2012, p. 81).[7]

3.1.4 Definition: Safety-related decision making

Based on the above literature, *safety-related decision making* is defined in this thesis as follows:

> Decision making involving potential safety-critical aspects, usually in work situations, by groups of coworkers at one or more levels of an organization – during operations, management, rule-enforcement, and other activities.

Safety-related decision making is directly related to safety-critical aspects or carried out in situations which can lead to or prevent accidents with at least one of Rasmussen's (1997) three safety elements: personal, economic, or environmental. This includes typical work tasks at all organizational and societal levels, from operational personnel all the way up to regulators and politicians.

[7] Dekker associates discretionary space with individuals, especially in relation to personal accountability and responsibility. In this thesis, I also use it with groups and their entire context, since discretionary space is important for and closely connected to decision making among several actors in the maritime industry.

This thesis analyzes how safety-related decision making is carried out according to the actors' decision criteria in relation to their constraints (see Table 5 in Chapter 4 and Rosness (2009) for an overview of criteria and constraints). It relies on the sociological understanding that people usually make the decisions they see as fulfilling the criteria they value with the information and situational awareness they have (Dekker, 2017a; Månson, 1996b; J. Rasmussen, 1997; Schiefloe, 2003). They do not make ill-advised decisions because they want to, but decide according to the discretionary space they have between given structures. Safety-related decision making can still lead to accidents or unfavorable conditions for others' safety-related decision making, depending on the decision criteria and situation. The research relevant to safety-related decision making on different levels is presented in Chapter 4.

3.2 Safety regulation with companions

The question of who should be responsible for safety and with what instruments changes with the idea of safety that is adopted (Gherardi & Nicolini, 2000, p. 344). The best approaches to achieve safety are continuously transformed in meetings between regulators, companies, and employees (Gherardi & Nicolini, 2000; Latour, 1987). For a long time, safety in organizations was understood as an employer responsibility, but employers often focused only on economic profit. During industrialization, the idea arose that others could help organizations improve safety. Safety in organizations became a matter of interest for politicians, insurance companies, regulators, unions, academia, consultants, and the general public (Aldrich, 2010).[8] In the years after, l*egitimacy* has become an important value for organizations: to stay in business, organizations had to earn trust and a good reputation by demonstrating that they operated according to society's values (Kongsvik, 2006; Røvik, 1998). Legitimate organizations were expected to take responsibility for their personnel's safety and those organizations' surroundings, especially in ecological terms. Safety demands from society continue to increase and become more evident (Amalberti, 2013).

3.2.1 Regulation definition

Regulation is "potentially one of the most important defenses against organizational accidents" (Reason, 1997, p. 182). It serves to bridge the gap between the state and the market—or between the public's interests in safety and cheap commodities. Regulation is in essence about decreasing some actors' discretionary space by shaping their criteria: the term *regulation* generally refers to a public agency's authority over an activity that is seen as important (Selznick, 1985). The purpose is to protect employees, customers, and society, among other stakeholders (Grote & Weichbrodt, 2013). The public do not trust market forces to choose the safest alternative (Johnson, 2014), so organizations are no longer allowed to adopt safety measures out of their own interest (or through the mimetic isomorphism or normative pressure

[8] As most of the literature and research stems from Europe, Northern America, and Australia, it is these publics or societies I refer to when I use term like "the society" and "the public."

described by DiMaggio and Powell (1983). Formalized pressure through regulation and control is preferred. Regulation is thus institutionalized at the governmental level and further transformed between the groups involved in safety management.

Regulation is to create a safe working environment. Regulation can help counter the alienation of workers, as described by Karl Marx (Månson, 1996a) and Robert Blauner (Amundsen & Kongsvik, 2008). On the other hand, regulation also can evolve into what Weber called *the iron cage* of bureaucracy or rationality, because one type of regulation approach can limit actors' discretionary space, thoughts, and new ideas (Månson, 1996b).

Baldwin et al. (2011) describe three different, but overlapping types of regulation:

1) A set of requirements enforced by a regulatory or supervisory authority
2) A deliberate state influence aimed at influencing organizations and individuals
3) All forms of social influence exerted over the behavior of the regulated actors, not only from states, but also from market mechanisms, for example.

In this thesis, the term *regulation* refers to type 1 and partly to types 2 and 3: regulation involves the *formal* set of rules or conventions made by governments or international policymakers and the states' enforcement of them. The formal enforcement of the ISM Code in Norwegian coastal transport consists of different types of influence from the Norwegian Maritime Authority and its recognized organizations, along with a more general influence exercised by the broader society. In this thesis, regulation is thus often contrasted with market or political influence on business and industry, even though all three elements are part of Baldwin et al.'s (2011) regulation type 3.

3.2.2 Safety regulation trends

The question of whether regulation is actually an effective safety measure is constantly debated. Increased safety regulation has coincided with more accidents (for example Le Coze, 2013; Maritime Authority, 2015a; Oltedal, 2011). Daniellou, Simard, and Boissière (2011) claim that regulation raised the safety level in organizations up to a point, but that law enforcement and compliance will not reduce today's accident numbers; that requires other measures in organizations. *How* safety is regulated has also evolved over the years. The conceptual development of safety has influenced its regulation, moving from equipment to working conditions and now to safety management and also damage to nature or society (Aldrich, 2010).

De-regulation leading to co-regulation

Deregulation has been a major trend in recent decades. States have tried to reduce, simplify, or remove regulations, usually in the name of free competition. Many business owners are in favor of fewer rules, and the public can also be reluctant to pay for regulators (DeSombre, 2008; Johnson, 2014; Walters & Bailey, 2013). Deregulation has led governments to shift more responsibility to companies. For example, according to the ISM Code, ship owners are responsible for ensuring safe conditions on their vessels. This rule is *function-based*, since it is up to the company to decide how to achieve this goal. By contrast, prescriptive rules describe

in detail what a given company must do. The term *self-regulation* is used when companies largely make their own regulations and systems.

Still, states want to maintain some control, so states demand that companies follow certain rules. For example, ship owners and vessels must acquire and renew ISM certificates, which are reviewed periodically. Therefore, the most common regulation type is called *enforced* self-regulation or *co-regulation*. The latter is more precise because it reflects the cooperation between the regulator and the regulated entities (Baram & Lindøe, 2013, p. 22).

In spite of what its advocates claimed, deregulation actually creates more bureaucracy, according to Dekker (2017b). Companies gain responsibility and freedom from detailed government rules, but must manage their own safety. Regulators give companies the freedom to manage their own safety, but regulators must still monitor the companies' ability to discover risks and manage safety. The companies must demonstrate that risk is managed in terms that regulators and lawyers will accept, such as written rules and documented checklists. This can lead to each organization's having to develop many safety procedures. Recent trends in function-based rules and accountability can help explain how this situation develops.

Function-based rules and safety management systems

Function-based rules focus on safety as a goal that the companies themselves know how to achieve (Reason, 1997; Skjæveland, 2003). Instead of prescribing detailed rules, regulators lay out safety management functions that companies should incorporate into a safety management system (Lindøe, Baram, & Renn, 2013). These rules "emphasize the required outcomes of safety management, allowing considerable freedom on the part of the operators of hazardous technologies to identify the means by which these ends will be achieved" (Reason, 2013, p. 175). See Lindøe, Baram, and Renn (2013) for discussions about problems and benefits of prescriptive and function-based rule sets.

Function-based rules offer companies options to ensure that their safety procedures match up with their business processes. This is designed "to encourage duty holders to go beyond mere compliance with regulatory requirements" since they have to take an active stance in how to best preserve safety (Sampson et al., 2014, p. 684). It also makes the procedures more sensitive to variations and easier to change while reducing public costs (Lappalainen, 2017, p. 10).

Safety management systems is the typical term for the arrangement of internal procedures. Functional safety regulations like the ISM Code oblige companies to develop safety management systems with written descriptions of and procedures for each operation, risk assessments, documentation of performance, etc. The systems must be internal but open to regulatory control. Regulations requiring them are therefore often called *internal control* regulation. Safety management systems have been increasingly demanded since the 1980s, even in countries, organizations, and industries where they are not formally required (Xue et al., 2015).

Companies develop safety management systems by different means. Paradoxically, function-based rules do not always lead to practical procedures designed for a company's operations (Hale & Borys, 2013b). Consultants and scientists in the safety area have created an industry out of offering and creating safety management strategies (Provan, Dekker, & Rae,

2017), similar to how management consultants have operated (Røvik, 2007, p. 64). Function-based rules stem from a wish for de-bureaucratization and a slimming of organizational structures but have actually led to a re-bureaucratization of organizational procedures (Røvik, 2007, p. 219). Simple function-based government regulations are accompanied by detailed safety management systems, bureaucracy, and controls in the companies, as the next section explains.

3.2.3 Safety rules: Artifacts of accountability, audits, and legitimacy

The public relies on governments to ensure that activities are safe for society, employees, and the environment. Governmental regulators usually possess the legitimacy to regulate fairly and correctly. For deregulation and functional rules to be possible, governments must demonstrate that such rules are legitimate (Baram & Lindøe, 2013). Governmental regulators must show that they can provide effective oversight on industries that are self-regulated (Baram & Lindøe, 2013). Governments can only employ functional rules if an industry is itself accountable and takes its risks seriously (Dekker, 2012, p. 8).

Accountability means demonstrating the existence of measures to prevent harm (Dekker, 2017b). A firm's activities must be accounted for in an auditable, transparent, and therefore measurable way (Power, 1999, 2007). Thus, functional rule sets demand internal control by the companies, which is itself externally monitored by regulators. The monitoring of compliance is as important as compliance itself, as explained below. Dekker (2017) offers deeper explanations of the history and trends in society leading to safety bureaucracy, standardization, control, legibility, and so on, and Baram and Lindøe (2013) provide several perspectives on private organizations' accountability in a deregulatory atmosphere.

Regulatory requirements influencing safety management regulation

Companies must demonstrate accountability for many reasons, not just to comply with governmental regulation. Financial supporters, insurance companies, and other stakeholders also demand safety accountability (Baram & Lindøe, 2013). This can promote safety management, but it also can direct safety regulation compliance in unexpected directions. For example, liability law can result in extensive safety management systems because management wants to protect itself through detailed descriptions of task operations (Hood, 2011). The creation of a system of heavy personal accountability for the employees can lead to anxiety and stress and affect performance in safety-critical tasks (Dekker, 2012), transforming safety into a bureaucratic accountability *to* people instead of an ethical responsibility *for* people (Dekker, 2017b, p. 128). The various types of social controls are shaped by the context and are out of the hands of regulators:

> A regulatory regime is not empowered to cure this problem by orchestrating all social controls and the factors that shape them into a coherent system for promoting safety because its statutory mandate does not provide it with authority to adjust corporate governance, liability law, private insurance, market forces, and other social controls. (Baram & Lindøe, 2013, pp. 38-39)

Demonstrating accountability through being auditable

Operations must be audited, monitored, and checked to demonstrate accountability, which is thus often combined with documentation and written procedures of all activities in an organization. These paper trails can give supervisors the ability to ensure that rules are being followed without examining the actual work (Hood, 2007, p. 1996). Bureaucracy is the background for society's belief in documentation and procedures as means to control risks; and bureaucracy involves differentiation of the systems (Eisenstadt, 1959, p. 306; Månson, 1996b).

Auditing is about ensuring that systems have the ability to govern safety or whatever is being examined. Auditing requires measurement and discipline at the expense of trust, dialogue, and autonomy (Power, 1999). To audit accountability fairly, there is a need for measurable tasks—standardized, objectified, and quantifiable (Jensen & Winthereik, 2017). When an organization standardizes its tasks, they are documented and can be audited and compared with tasks in other organizations or industries. Standardizing is closely related to bureaucracy. Standards also allow information to move easily between contexts (Almklov, 2008; Latour, 1987), since tasks are separated from personnel and organizations from tasks, as in Weber's initial values of bureaucracy (Månson, 1996b, p. 96). Standardization certainly has drawbacks like the negative sides of bureaucracy and professional alienation (Amundsen & Kongsvik, 2008, pp. 132-134; Bieder & Bourrier, 2013; Månson, 1996a, 1996b). In addition, standardizing is best at preventing known hazards; it can have negative effects on crisis handling. Standardization of safety management systems also can lead to disempowerment, loss of local knowledge, increased bureaucracy, and less hands-on management (Antonsen et al., 2012).

Rules standardize tasks, making work suitable for documentation and auditing (Hohnen & Hasle, 2011). Rules are a quick and easy basis for checking compliance (Hale & Borys, 2013a). Regulators and many companies regard rules as artifacts of accountability, making it necessary to follow all rules to demonstrate that everything has followed procedures (Hale & Borys, 2013c). This is based on an understanding of rules as limits on the freedom of choice to suppress negative behavior (Hale & Borys, 2013a):

> The quality management and auditing industry favour written procedures for these reasons of transparency, and hence create major incentives for companies to write weighty procedure manuals but tend then to be blind to the gap with reality which a paperwork-based system audit does not pick up. (Hale & Borys, 2013a, p. 230)

Having a safety management system has become a requirement of legitimacy and accountability (Dekker, 2017b, p. 110). Many actors regard safety management systems as having become too extensive, bureaucratic, and focused on documentation, thus creating a risk rather than ensuring safety (Antonsen et al., 2012; Bieder & Bourrier, 2013; Dekker, 2014; Vandeskog, 2015; Walters & Bailey, 2013; Walters et al., 2011). A one-sided focus and overreliance on safety management systems can suppress other organizational functions and thus increase risk in areas those systems do not examine (Power, 2004, p. 49). Unpredicted risks require an opposite approach to following rules, as they demand practical experience and the ability to improvise (Hale & Borys, 2013a; Hohnen & Hasle, 2011). This is not sufficiently recognized in our audit society.

Audit explosion and audit implosion

In the 1990s, Power (1994, 1999) described an audit explosion in Western society. As we have seen, many conditions have led to pressure for auditable risk management (Power, 2007, p. 153) in both the public and private sectors (Hohnen & Hasle, 2011). As with other institutionalized organizational ideas, audits soon appeared as natural solutions to problems, without questioning whether other measures might be better (ibid).

Jensen and Winthereik (2017) have studied how the audit society notion has spread internally in organizations, leading to an *audit implosion*. The idea of audits has spread so much that it has changed knowledge making (Jensen & Winthereik, 2017, p. 176). Auditing has become a way of thinking of and building knowledge. Auditing loops are "mutually shaping interactions between auditors and auditees that cross organizational barriers in multiple directions, both 'downstream' and 'upstream.'" (Jensen & Winthereik, 2017, p. 161). Audits construct the environments they operate in to make them more auditable, with failures simply calling for more auditing (Jensen & Winthereik, 2017, p. 177). The term audit implosion does not mean that audits are vanishing, because there is no sign that they are. Implosion rather refers to how audit implementation has changed. Audits were supposed to be detached from core activities, following another set of rules than those activities, but the audit way of thinking is now embedded in our whole society, even in how we operate and create knowledge. This is an enormous change and an important phenomenon relevant to my discussion of how the ISM Code influences coastal transport. Power (2007) has also used the term audit implosion to indicate an audit transformation toward more internalization: organizations perform audits and carry out internal controls themselves and thus become more reflexive.

In this thesis, however, I use the term *audit implosion* differently. Based on dictionary definitions of implosion, I employ *audit implosion* in its more common-sense understanding, as if our audit society had collapsed and audits became as concentrated and minimized as possible.

3.2.4 Potential future safety regulation

Researchers have argued that the time has come to invent entirely new safety measures, with new regulations if regulation is indeed the right approach (Amalberti, 2013; Bieder & Bourrier, 2013). Amalberti (2013) describes society's demands for more safety in organizations; in response, he urges that organizations, in order to survive the next generation of safety regulations, to take the lead and invent and implement approaches to demands that are not yet requirements.

Power (2004) states that we need to face uncertainty in more intelligent ways. New safety measures must accept a degree of disorganization and provide "a space for decision-making where competence may flourish and express itself" (Power, 2004, p. 63). The possibility of failure should be legitimate, and actors must be encouraged to be reflective. Organizations should measure success rather than simply following the rules. Parts of today's internal control systems might work, and can be preserved. Legal consultants could be counseled, and might find that such disorganized and simplified systems actually comply with regulation.

Dekker (2012) has a similar vision of how to maintain organizational accountability without making employees personally accountable by making their discretionary space clear.

For example, “accountability could come in the form of reporting or disclosing how an assessment or action made sense at the time, and how changes can be implemented so that the likelihood of it turning into a mistake goes down” (Dekker, 2012, p. 50). He advocates more employee participation in organizational improvement (Dekker, 2017b). That way, safety can be promoted, not as a bureaucratic accountability imposed from above, but as horizontal guidance. Dekker has had success with experiments in some organizations that have removed all existing rules and procedures and given their personnel maximum space to decide how to operate safely, with the support that is needed from management. Safety improved, and communication and support in organizations went up (Dekker, 2017b).

4 Rule influence on safety-related decision making: Research to derive research questions

This chapter demonstrates how earlier research on safety, decision making, and regulation sheds light on the thesis topic. This section lays out each level's decision setting, with each subsection ending with research contributions about maritime regulation.

Figure 6 shows five decision settings based on proximity to a hazard and to the level of authority (Rosness, 2009): political arenas, administrative and technical functions, business management, operations, and crisis handling, which can all be situated on the continuum from blunt to sharp end (Dekker, 2006). As this thesis is about how regulation affects decision making by maritime regulators, company management, and operational personnel, the levels of business management, administrative functions, and operations are the primary focus. Some literature regarding political arenas is also included, since that is where regulations begin and from which they are supposed to trickle down. This thesis is about the *prevention* of crises and accidents, so I omit the crisis-handling decision setting. Figure 6 offers an illustration of the decision settings on different levels; the categories' limitations and positions relative to each other will not be discussed in further detail.

Figure 6: A typology of decision settings (Rosness, 2009, p. 808)

Table 5 is the theoretical backbone of this chapter; it combines the literature introduced in Chapter 3 about safety, levels and settings, decision making, and regulation. Rosness (2009) is used in Table 5 to encapsulate decision settings, constraints, criteria, and modes for the relevant organizational levels. The content of the table is described along with the relevant safety research, after which the research questions about decision making by regulators, management, and operational personnel are presented.

Table 5: Characteristics of decision settings (Rosness, 2009, p. 809)

Decision setting	Dominant constraints	Dominant decision criteria	Representative decision modes
Political arenas	Conflicts in interests	Robust consensus	Muddling through
	Changing constellations of power	Secure status of decision maker	Symbolic decisions not necessarily followed by action
Administrative and technical support functions	Limited hands-on knowledge	Compliance with rules and standards	Extensive reuse of solutions
	No authority to enforce decisions	Consistency	Intermittent, limited optimization efforts (one attribute)
		Optimization of a single attribute	
Business management	Information-processing capacity	Optimizing profit (or other key performance indicators)	Satisficing
		Avoiding trouble	
	Dependence on information filtered by subordinates	Ensuring commitment or compliance	"Irrational" decision making devised to gain commitment
		Making decisions efficiently	
Operations	Workload	Smooth and efficient operations	Skill- and knowledge-based action intermittently
			interrupted by knowledge-based problem solving
	Limited situational awareness	Acceptable workload	Recognition-primed decision making

4.1 Political arenas

Regulations and the directions for their enforcement are shaped by representatives at the political level, which involves political parties and interest groups. Therefore, the political arenas' decision setting, constraints, and criteria are briefly described here, following research about the ISM Code.

According to Table 5, the decision criteria relevant in this setting are finding robust consensus and securing the status of the decision maker. These criteria are intertwined with the decision constraints of conflicts among interests and changing constellations of power.

4.1.1 General research

Complex consensus

Norwegian political transport safety structures appear stable despite changes in the constellations of power in parliament. The politically divergent governments of recent decades have had almost the same positions about moving more transport from road to sea for both safety and environmental reasons (Norwegian Cabinet, 2005, 2009, 2013), although none have succeeded. Both the goal and failure to have more sea transport might be due to the decision criteria of obtaining a robust consensus and securing the decision makers' status, because

politics can be symbolic decisions not necessarily followed by action (see Table 5). Governmental and societal structures are difficult to change in practice, which can lead to the impression that politicians or public servants are incapable of action (Lindblom, 1959).

Other actors with conflicting interests also exert powerful influence on decision making and implementation. In both domestic and international political processes, lobby organizations have the opportunity and ability to speak on behalf of the public, or parts of the public (Lindøe, Engen, & Olsen, 2011). The political actors depend on one another, different organizations, and the industry on a global level to be able to actually change policies.

Conflicts underneath

As in all political settings, safety policymaking includes conflicting interests, because, for example, "safety has a high priority, but so has employment and trade balance" (J. Rasmussen, 1997, p. 184). Actors can argue for positions and use pressure to influence decision makers if they have sufficient resources (Renn, 1992). Formal power is often not enough to convince others to decide according to one's criteria: authority must be accompanied by other resources like social influence and financial capacity.

Many arenas are so full of political constraints that decisions are not necessarily made in accordance with the values of any of the participants. This is the decision mode of "muddling through," in which policies are ultimately chosen because they are achievable and practical to agree upon rather than rationally analyzed to fit the need (Lindblom, 1959). If none of the actors have enough resources to dominate the process, issues can remain unresolved and *political paralysis* can arise, leading to symbolic decisions not necessarily followed by action (Renn, 1992). Political paralysis occurs when several actors fail to cooperate and decide on collective measures because they have different values and goals.

4.1.2 Maritime policymaking in despair

Most maritime regulation is developed in cooperation between actors in an international maritime arena full of conflicting interests (DeSombre, 2006; O. F. Knudsen & Hassler, 2011; Kristiansen, 2013). Each party, including national states, focuses on its own interests. Expensive safety regulation is not of interest to either companies or taxpayers (Walters & Bailey, 2013; Walters et al., 2011), except in sectors with significant public attention (Lindøe, Engen, & Moen, 2011). Industry actors tend to exert pressure for low-standard policies (O. F. Knudsen & Hassler, 2011; M. S. Roe, 2008, 2013). The different perspectives of the many stakeholders lead to slow development of regulations and sometimes renders them impossible (Kuronen & Tapaninen, 2010).

In addition, globalization has been called a nightmare for policymaking (M. S. Roe, 2013). The ability to flag out vessels, crew, and operations enables ship owners to choose among registration states and thus regulations (Couper, 2000, p. 171; M. S. Roe, 2013, p. 6). Flag states have different levels of implementation and monitoring of regulations (O. F. Knudsen & Hassler, 2011; Lappalainen, 2017). Some allow crews of any nationality and have comparatively lax labor standards, offering companies a chance to cut costs (Bhattacharya & Tang, 2013; Lappalainen, 2017), and flag state competition has reduced states' willingness to

enforce standards (Bennett, 2000, p. 877) and led to less uniform and effective regulation (M. S. Roe, 2013, p. 171). Even regulators use the globalized competition and profit arguments about trade coming first (Walters & Bailey, 2013). When states compete to be attractive for ship owners, with modest fees and low regulatory demands, there is a negative effect on overall sea safety levels (DeSombre, 2006, 2008; Roberts, Pettit, & Marlow, 2013).

Maritime regulation has been reported to be a failure because international regulation depends on national development and enforcement in a global industry that can choose the regulating state (Kuronen & Tapaninen, 2010; M. S. Roe, 2013). Another problem with existing policy instruments is their technical focus and avoidance of addressing how safety can actually be achieved (Kuronen & Tapaninen, 2010; Schröder-Hinrichs et al., 2016). Development of supranational regulation is thus as important as it has ever been, and stakeholder involvements need to be broadened (M. S. Roe, 2013).

Several researchers have recently argued for a paradigm shift in maritime safety regulation (M. S. Roe, 2013; Schröder-Hinrichs et al., 2016; Xue et al., 2015) or, at a minimum, a rethinking and further development of policies (Kuronen & Tapaninen, 2010; Schröder-Hinrichs et al., 2016).

However, that further development of safety management regulation is considered to be impossible, or at least unlikely, as long as safety standards can be traded off for profit (O. F. Knudsen & Hassler, 2011; M. S. Roe, 2013). Development of more rules for the maritime industry are opposed, because they might simply add to the negative aspects of existing regulations and enforcement issues (O. F. Knudsen & Hassler, 2011). The IMO itself has also declared that regulation is sufficient; it is the implementation and enforcement that need improvement (Bennett, 2000, p. 877). The next section presents research about the main safety management regulation, the ISM Code, and its benefits, drawbacks, and potential for improved implementation.

4.1.3 Research regarding the International Safety Management Code

The ISM Code is a holistic and integrated approach to safety management that deals with many topics (Batalden & Sydnes, 2014, p. 4). It was adopted to facilitate better opportunities to make safe decisions on board by making companies responsible for safety management on their vessels. An improved safety culture was one of the desired effects of the IMO Code (Bhattacharya, 2009, 2012; Lappalainen, 2008, 2016).

Several studies have focused on the effects of the ISM Code itself (Anderson, 2003; Batalden & Sydnes, 2014; Bhattacharya, 2009, 2012; Christophersen, 2009; Jense, Eldh, & Wengelin, 2008; Knapp & Franses, 2009, 2010; Lappalainen, 2008, 2016; Lappalainen, Kuronen, & Tapaninen, 2014; Lappalainen et al., 2010; Oltedal, 2011). These studies deal with different parts of the world but show similar patterns. The general conclusion is that the ISM Code can be a positive contribution to maritime safety, but that it also has resulted in significant and negative unintended effects.

Positive statistics and safety measures

Maritime safety regulation has decreased the number of casualties and their seriousness, according to Knapp and Franses (2009, 2010); Kuronen and Tapaninen (2010). Some safety statistics have shown improvement within the Paris MoU and other MoUs (Jense et al., 2008).

Most qualitative and mixed studies of the ISM Code have shown that it has influenced work at sea positively. Lappalainen (2016, 2017); Lappalainen et al. (2010) demonstrate the ISM Code's positive contribution to safety on Finnish vessels and report that crews have a positive view of the Code. By 2010, crews' safety thinking and awareness had increased and accidents had decreased in Finland since the ISM Code's adoption (Lappalainen et al., 2010). In both Finnish and Norwegian shipping, it has been reported that when ship-owning companies are responsible for safety on their vessels they apply greater safety measures than previously, resulting in improved safety culture (Lappalainen, 2016); (Oltedal, 2011). Jense et al. (2008) found positive effects of the ISM Code on Swedish cargo transport; in particular, it led to improved organization and handling of safety training.

The ISM Code is also required on fishing vessels, but fishers still mainly use their own experience in safety-related decision making, although they do value systematic knowledge as long as there is not too much paperwork (Grøn, Rasmussen, & Poulsen, 2014; Thorvaldsen, 2017). In recent years of Danish regulatory enforcement, however, safety and risk have gone from something not talked about to something discussed and actively hampered (Grøn et al., 2014, p. 32).

Negative views of safety management systems

Many studies have concluded that the ISM Code results in a "high regulatory burden and excessive inspections" (Lappalainen, 2017, p. 5). In the first large-scale ISM study, Anderson (2003) found that the Code was seen as an administrative burden that penalized initiative and discouraged innovative safety management systems because success was defined as being able to comply with audits. He found that many companies only implemented safety management systems on paper; their actual safety measures were not improved by adoption of the ISM Code. Even in 2003, maritime personnel expressed a desire for less paperwork and fewer documentation requirements.

A more recent body of literature has emphasized that many seafarers experience procedures and paperwork that are so complex that it becomes impossible to comply safely (Jense et al., 2008; Lappalainen et al., 2010; Schröder-Hinrichs et al., 2016). In Norwegian maritime research, the results indicate that a general reluctance about safety management dominates the scene (Aalberg & Bye, 2017; Antonsen, 2009a; Antonsen et al., 2008; Bye & Lamvik, 2007; Bye et al., 2012; Håvold, 2010; Kongsvik, Fenstad, & Wendelborg, 2012; Nævestad, 2016; Oltedal, 2011; Røyrvik et al., 2015; Vandeskog, 2015).

The lack of legitimacy that seafarers find in procedures poses a serious challenge to maritime safety management (Antonsen, 2009a), and the increased administration and bureaucracy in the name of safety can even increase risk (Antonsen et al., 2008; Antonsen et al., 2012; Soma, 2004b; Walters & Bailey, 2013). Making matters worse, a mature bureaucracy creates systems that make simplifying, revising, and eliminating rules difficult (Dekker, 2017b).

Non-existent positive outcomes, but is there potential?

Most researchers acknowledge that the ISM Code has flaws, but there are different opinions on whether it is a valuable regulation that can be improved. There are advantages and disadvantages because the ISM Code is a functional regulation that is deliberately general so that it can be implemented in different regions and sectors. This vagueness can result in extensive safety management systems. Many want guidance in how to implement the ISM Code (Lappalainen, 2016). Vagueness can also have the potential to foster maritime safety since it allows for practical interpretation and context-based decisions (Schröder-Hinrichs et al., 2016, p. 179). In practice, however, this innovative approach is non-existent, and there is a desire for safety management regulation that is less compliance-minded than the present ISM Code and how it is enforced (Bhattacharya, 2012; Schröder-Hinrichs et al., 2016) and less technical in its orientation (Sampson et al., 2014). Christophersen (2009) complains that the ISM Code does not take into account the complicated financial, environmental, and social conditions that determine whether compliance is even possible.

One desired outcome of the ISM Code is improved communication between vessels at sea and shore-based stakeholders. Although there are reports of improved communication (Lappalainen, 2016), others have found communication to be at least as bad as previously (Bhattacharya, 2009, 2012; Xue, Tang, & Walters, 2016; Xue et al., 2015). Many studies show the need for more commitment from the top, better relations between shore offices and vessels, and greater involvement of seafarers in the development of procedures and reporting (Anderson, 2003; Bhattacharya, 2012; Lappalainen, 2016; Lappalainen et al., 2010; Oltedal, 2011).

Better communication could be a means of improving areas where the ISM Code has not had its intended effect. Suggestions for improving the ISM Code tend to advocate more practically adapted safety management systems (Oltedal, 2011; Oltedal & Engen, 2010, 2011).

Generally, the need for more research on seafarers' opinions of policy instruments has been demonstrated (Kuronen & Tapaninen, 2010), as has the link between formal safety management systems and the conduct of operations (Bennett, 2000). A recent literature review (Xue et al. (2015) underlines the urgent need for an examination of the implementation of the ISM Code, especially using qualitative data.

4.2 Administration and regulators

Administrative and technical support functions refer to administrators with limited formal authority. Although this may not be intuitive, these can include public administration officials such as regulators, since their tasks and their discretionary space is set and limited by government. In this category, decision criteria must comply with rules and standards, consistency, and optimize a single attribute (see Table 5).

4.2.1 General research

Consistent compliance

Regulators are part of the development and enforcement of regulation and have a goal of consistency in compliance. They must comply with their own regulations and ensure that others comply with the rules that apply to them. Monitoring the industry is especially important, because well-monitored companies have a higher level of compliance with safety regulations than those that are not inspected, and compliance with safety regulation means fewer accidents (Dahl, 2014, p. 89).

The single attribute by which many regulators make decisions—and a decision mode of optimization of one attribute—is *accident prevention*. The Norwegian Petroleum Safety Authority's accident prevention approach and record has been exhaustively analyzed (to mention some, Antonsen et al., 2017; Kongsvik, Gjøsund, et al., 2016; Kringen, 2013; Lindøe, Baram, & Paterson, 2013; Nilsen, 2014); however, the Norwegian Maritime Authority's accident prevention record not as straightforward and has not received the same level of attention from researchers.[9]

Limited discretionary space for regulators with co-regulation

The regulator's power is limited by the co-regulation approach (Baram & Lindøe, 2013, p. 22). Function-based regulations delegate responsibility for fulfilment to the industry, with regulators serving in a supervisory role. Companies must have an advanced safety management system and internal controls, while the regulator must be competent to evaluate these systems(Baram & Lindøe, 2013). Co-regulation limits the authority's discretionary space because the authority must take the industry's situation into consideration. When regulations do not include detailed prescriptions, the content of the safety management system also relies heavily on each company's resources.

Co-regulation has primarily been studied in resource industries like petroleum and aquaculture. It is likely that an industry with small economic margins, like shipping, could employ less ambitious safety measures than the petroleum sector (Baram & Lindøe, 2013; Lindøe, Baram, et al., 2011; Lindøe, Engen, & Olsen, 2011). On the other hand, the maritime industry is constantly evolving, which can be challenging for a co-regulation regime, as has been demonstrated in aquaculture. Regulation of aquaculture is challenging because of the constant development and inherent uncertainty around the product, the environment, and the nature of regulatory organization (Osmundsen, Almklov, & Tveterås, 2017). This causes public administrators to lag; they are under pressure to adapt and update on a nearly constant basis, resulting in a suboptimal system and organization, always behind the industry. Osmundsen, Almklov, and Bjelland (2012) showed that Norwegian Food Safety Authority personnel were obliged to make decisions that balance between societal and industrial interests, but that rigid regulations can limit their authority, constrain their decision making, and sometimes result in

[9] As indicated in the next chapter and investigated in Article A (Størkersen, 2015b), the Maritime Authority has obligations be yond accident prevention; they also must appeal to ship owners (Maritime Authority, 2017).

irrational decisions. This might be why extensive reuse of solutions and limited optimization efforts are common decision modes.

It is essential for regulators to have good communication with industry. With limited formal authority, regulators are routinely in need of information from the industry they regulate.

Limited hands-on-knowledge and the lot

To enforce functional rules is a difficult task: co-regulation demands competence from the regulators. They must both look for departures from generic safety regulations and check the compliance of internal safety management systems (Reason, 1997, pp. 181-182). The supervisors do not have their own detailed rules with which to confirm compliance; rather, they have to search for deviations from the companies' own safety management systems, which demands additional qualifications compared to previous rule regimes (Power, 2007; Reason, 1997, pp. 181-182). This involves a comprehensive understanding of all factors contributing to all types of accidents. However, regulators usually lack tools, resources, and training. This might be why auditors often ensure that safety management systems are in place, not how they are used (Power, 1999).

The simple reality is that regulators have less industry competence than companies. Regulators will always be out of date and lacking oversight, since "organizations tend to be highly selective in their transactions with external organizations, and especially with regulators" (Reason, 1997, p. 174). Regulators can appear to lack the practical knowledge and experience needed to formulate useful rules (Johnson, 2014; E. Roe, 2013).

Still, regulators must maintain good relations, since they need information provided by and the cooperation of industry to ensure that regulations are complied with (Baram & Lindøe, 2013; Bratspies, 2009; Grote, 2012; Skjæveland, 2003; Walters et al., 2011). Regulators must have dialogue with companies to find out what level of enforcement is realistic, as Vaughan (1997) details. Dissatisfaction with regulations reduces the regulated entities' and the public's trust in the system (Bratspies, 2009). Each regulation development must consider the actual context to avoid unintended consequences for safety (Rosness et al., 2012). The public expects regulators to have much formal power and to threaten with sanctions, but their relationships are actually "based more upon bargaining and compromise" (Reason, 1997, p. 173).

Regulators are in an impossible position, according to Reason (1997). As with personnel on any level of an organization, they experience increased workloads and need to balance conflicting goals of efficiency, thoroughness, and safety. In addition, they must enforce regulations and will be criticized for either being too strict (trying to make companies go bankrupt) or too lax (in the companies' pocket). Regulators are also expected to prevent accidents that no one can foresee, but they never will be entirely correct about which accidents are about to happen, because if they issue a warning and implement measures successfully, the accidents they have foreseen will not happen. They need resources to cope:

> If regulators are to be other than convenient scapegoats, they will have to be provided with the legislation, the resources and the tools to do their jobs effectively. They are potentially one of the most important defenses against organizational accidents.… Let's hope that, in the next millennium, the regulators are seen to deserve something better than has so far been the case. Then, perhaps, we will all be safer. (Reason, 1997, p. 188)

4.2.2 Maritime research

Maritime regulators' influence on enforcement

In the maritime field, national regulators implement and enforce international conventions based on national ratification (O. F. Knudsen & Hassler, 2011). Even though the ISM Code consists of functional regulations, states play an important role in enforcing it (Bhattacharya, 2009). The ISM Code must be interpreted and operationalized by regulators and related auditors, which means that such conventions also influence practical regulations unintentionally (O. F. Knudsen & Hassler, 2011). Maritime regulators certainly experience the co-regulation problems described in preceding sections about the need for both competence and trust, which leads to conflict (Bhattacharya, 2012). Fenstad, Dahl, and Kongsvik (2016) find that passenger ship owners display a critical trust in the Norwegian Maritime Authority, feeling that the industry's competence makes it right to be critical about the authority, given that it is the companies that are the main investors in safe working conditions.

Some unintentional influence goes through the government-appointed recognized organizations and other third party organizations: charterers, insurers, classifications societies, banks, and the like all influence standards and safety management systems (Bennett, 2000; Kuronen & Tapaninen, 2010): "Actual enforcement has always been carried out by private Classification Societies, themselves competing for the business of ship owners—the very companies they are regulating" (Bennett, 2000, p. 877). Charterers' influence on safety can also be considerable (see Sampson et al. (2014), but it is not a central topic of investigation in this thesis.

Vessel control

Maritime companies and vessels are frequently reviewed, at least those with vessels registered in states that are active. Each supervisory regime is independent of the others (Kuronen & Tapaninen, 2010), even though they deal with similar aspects in their standardized regimes (Knapp & Franses, 2009). The content of control differs from state to state (Jense et al., 2008), partly because inspectors interpret the regulations differently (Gåseidnes, 2014; Lappalainen, 2017; Rodríguez & Piniella, 2014). Anderson (2003) also found large differences between auditors, especially between internal and external auditors. His informants had major concerns about auditing techniques and the new industry of auditors, even in the ISM Code's first years. In a study of the Swedish coastal sector, Jense et al. (2008) found that reviewing types overlap, are time consuming, and too often announced in advance. More control or new regulation to be controlled is still not the solution, according to a literature overview by Lappalainen (2017).

Functional rules such as the ISM Code are considered difficult to manage, but its oversight is still seen as valuable: "The flexibility provided by the ISM Code may make it challenging to assess" (Batalden & Sydnes, 2014, p. 4). Aae and Heggøy (2013) report that Norwegian ship owners were frustrated over supervisors' different interpretations of the ISM Code, although formal inspection was still regarded as important for compliance. The companies themselves want inspections to eliminate companies that do not comply (Bloor et al., 2013). Batalden and Sydnes (2014) and Fenstad, Størkersen, and Solem (2010) both found

audits to be perceived as positive by UK and Norwegian shipping companies and crews, respectively, as long as auditors took their time and made the effort to obtain a real picture of onboard operations.

In a study of regulatory compliance, Sampson et al. (2014) describe how compliance is a complex interplay between traditional enforcement and market-based mechanisms. They found that flag state controls did in fact ensure compliance with rules about health and safety management. Port state control officers, however, stated that crew safety was not of interest to them; they dealt mostly with environmental issues or vessel technicalities (Bloor et al., 2013; Sampson et al., 2014, p. 393).[10] In some maritime sectors, charterers' buying powers influenced safety compliance, but "market forces alone would not serve to achieve the same degree of compliance as is achieved via such traditional forms of enforcement" (Sampson et al., 2014, p. 398). Overall, a combination of review and safety measures is important to maintain safety standards. Sampson et al. (2014) urge regulators to use the information from their study to improve their impact.

4.2.3 Research question 1

The literature presented in this section indicates that regulators' decision making is limited by policies and industrial structures. Co-regulation is a trend that affects regulators deeply, since it demands cooperation with companies and thus challenges the traditional relations and qualities of regulators' decision making. This is certainly common among maritime regulators, since the ISM Code is based on functional regulations and has to be implemented and enforced nationally.

Research on regulators' handling of co-regulation is scarce. There are some studies in the maritime industry about the relationship between regulators and companies and about oversight and inspection, but these mostly serve to underline that we need more knowledge about the regulators' situation. In addition, the relevant safety literature focuses on industry organizations and other influential stakeholders, rather than representatives of authority.[11] I have not found any studies about how safety management regulation influences regulators' decision making in any industry.

It is even difficult to find earlier studies about general decision making by authority representatives. Table 5, an assembly of organizational decision-making literature gathered by Rosness (2009), demonstrates a gap in decision criteria and constraints for public administrators with power and authority. Most Norwegian regulators are administrators on behalf of political ministries, but they also often lead policymaking processes. In this thesis, I place the regulators in the administrative support category, but this might not always be perfectly accurate. Therefore, it is worth learning more about the decision making of regulators in general.

Because closer investigation of regulators' decision making is called for, the problem addressed in this thesis ("How is safety-related decision making in Norwegian coastal transport

[10] This is opposite to Bennett (2000)'s slightly earlier conclusions that port state controls were efficient.
[11] Note that research about Norwegian regulators' decision making does exist for other sectors: rail (Rosness, 2013), the oil and gas industry (Engen, 2014; Kongsvik, Gjøsund, et al., 2016; Lindøe & Engen, 2013), and aquaculture (Osmundsen et al., 2012; Osmundsen et al., 2017).

affected by the International Safety Management Code?") should include a research question about regulators (RQ1):

> How is regulators' safety-related decision making affected by the International Safety Management Code?

In this thesis' articles, the regulators are explored in Article A (Størkersen, 2015b) and Article B (Størkersen, Antonsen, & Kongsvik, 2017).

4.3 Company management[12]

In this section, I review the literature relevant to safety-related decision making by corporate management in costal transport. The decision criteria for the business management setting set out in Table 5 are to *optimize profit* (or other indicators), *avoid trouble, ensure commitment or compliance*, and *efficient decision making*, while constraints are *information processing capacity* and *dependence of information filtered by subordinates*. The decision modes here are "irrational decision-making" and "satisficing" (related to bounded rationality presented in Section 3.1.3.).

Given that Norwegian ship-owning companies are responsible for implementing safety management systems in their organizations and on each vessel, regulation might conflict with profit. However, these managers must make decisions about safety regulation according to other criteria. They are to establish procedures that comply with regulations, company policies, and other relevant actors' demands and values.

4.3.1 General research

Profit, efficiency, and resilience

Business managers often experience conflicting demands such as costs and safety. One goal is to optimize profit, which allows them to easily understand the process and value of product-handling (where failure can lead to bankruptcy); however, it is harder to recognize the processes and value of employee or organizational safety, even though failure can lead to catastrophe (Reason, 1997). Therefore, managers can value short-term financial criteria over welfare, safety, and environmental criteria (J. Rasmussen, 1997). The criteria of optimizing profit and efficiency can cause decision making to conflict with safety (J. Rasmussen, 1997; Reason, 1997). Amalberti (2013) writes about company management's trade-offs between performance and safety. Even though a lack of safety could make a company go bankrupt, safety can never be a business's only goal. Companies should instead aim for adequate performance and safety

[12] The "company" and "management" levels in Figure 5 (J. Rasmussen, 1997), are combined in this thesis. Of course, a company might be made up of shareholders, board members, and other internal policymakers, while the daily and operational management can be understood as following the board's policies and transforming them into action. Board members were not targeted for interviews in this thesis. In Norwegian coastal transport, however, the board is often the same group as the managers, or the managers find that boards leave safety-related decisions to them.

and admit they have to compromise on safety to balance other goals. Excessively rigorous safety strategies can lead to overall failure.

To ensure efficiency, compliance with safety management regulations, and avoid trouble, managers can facilitate the conditions that give the staff the possibility to work safely. Here we can employ terms from *resilience engineering*, which deals with management's increasing an organization's capacities to respond, monitor, learn and anticipate, and the dependencies and couplings among them (Hollnagel, 2011; Hollnagel et al., 2008; Hollnagel et al., 2006). Managers must facilitate readiness and ensure that resources are available. Threats and opportunities can be anticipated and treated safely if the organization monitors both its own activities and external developments (accidents, resources, innovation, or customer demands) and successfully interprets what is important. This is not equal to risk assessment, since it is important to anticipate both negative and positive potentialities. Resilient organizations operate over long time horizons and are open to uncertainties and new perspectives.

In addition, managers must ensure that their organizations learn the right lessons from the right experiences, as by focusing on situations that happen frequently (operations that "go right" rather than wrong). If management makes sure that their organizations can operate under difficult situations, they become able to respond to variability and abnormal situations (Hollnagel, 2011). Managers should take time to reflect upon potential surprise situations, their reactions to them, and how to turn them into possibilities (Rosness et al., 2010). However, nobody can ever anticipate everything and human information processing capacity is limited, so a resilient organization is prepared to be unprepared—it is both ready and creative (Hollnagel, 2011). This involves providing employees with the right resources and giving them the discretionary space to make their own safety-related decisions.

Commitment and compliance through safety management systems

Managers are advised to develop safety management systems that reflect the personnel's actual activities (Hale & Borys, 2013a). Dekker (2003, 2017b) teaches managers about the gap between procedures and practice and how important managers' decision making is for the personnel. Still, many procedures and safety management systems remain notably theoretical and extensive. They have been called blueprints and fantasy documents designed so that managers can have a feeling of controlling the uncontrollable (Power, 2004, p. 50), as described in Section 3.2.3 about accountability.

A key result from a large study in the Norwegian oil and gas industry is that procedures are often perceived as difficult to understand, access, and follow, even though reasonable procedures are of utmost importance for personnel to comply with directives (Dahl, 2014, p. 87). Dahl (2014) emphasizes, based on his own research and earlier literature, that procedures should be clear, easily available, trainable, and preferably tailor-made by the personnel themselves. Sharp-end personnel must be made aware of the connection "between the procedures and the risks they are meant to reduce," particularly if they have tasks that are perceived as routinized and predictable (Dahl, 2014, pp. 88-89).

Grote (2012, 2015) insists that procedures must be both sufficiently broad and detailed to find the right balance of stability and flexibility. Managers and regulators involved in safety management should find a manageable degree of uncertainty to make regulations that facilitate

both stability or flexibility. Figure 7 shows that stability is required if the processes are tightly coupled, decisions and processes are traceable, and the fault tolerance and qualifications of personnel are low. One needs flexibility if external changes are frequent and work processes have high variance, when one wants to avoid over-proceduralization and complacency, and when one needs innovation.

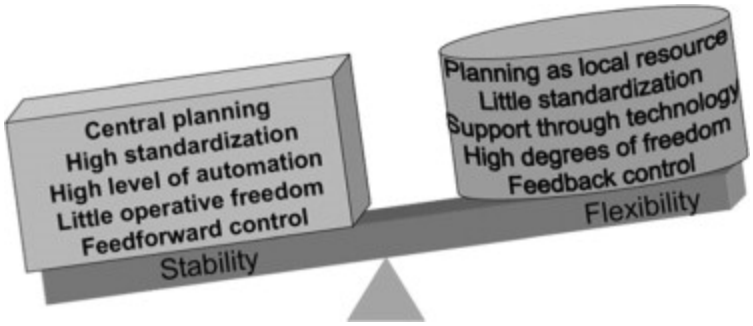

Figure 7: Balancing stability and flexibility through management of uncertainty (Grote, 2012, p. 1985)

Hale and Borys (2013a, 2013c) urge managers to balance top-down and bottom-up approaches, emphasizing that managers should obtain input from operational personnel, legal experts, and others when creating and maintaining safety management systems. Since many operations are performed or prepared by a broad range of professionals, many expert areas must be involved in decision making to obtain well-informed plans or procedures (Halvorsen, 2015, p. 45).

Limited capacity and information

Managers need time and space to be able to develop balanced procedures that comply with regulations and are adapted to operational reality. In the busy day-to-day work environment, it is rare to be able to weigh a full set of pros and cons before making a decision. If safety management systems operate in a "satisficing" decision mode, that might explain why the operational levels seldom find their procedures adequate (see for example Bieder & Bourrier, 2013). A gap between sharp- and blunt-end understanding and decision making is present in most organizations. The Norwegian work sociologist Sverre Lysgaard (1961) has studied how the *Workers' collective* fought against managers' rules and exploitation by creating their own strict rules, to which all personnel must comply with to be regarded loyal (there is more on this in Section 4.4.1 about operations).

4.3.2 Maritime research

Safety versus profit in the maritime market

Maritime management's decision making is influenced by *profit optimization*, to *ensure compliance* with safety regulations, and to balance many other goals. In a quantitative study about the safety climate on high-speed passenger vessels, Fenstad et al. (2016) found that management heavily influences seafarers' decision making, especially through their signals on how to balance safety and efficiency. Managers were unaware that their efficiency decisions

negatively influenced safety. Better-informed decisions could be valuable for both profit and safety.

Compliance with safety regulations varies between regions, regulations, and sectors (Bloor et al., 2013).

In some parts of maritime transportation, a company with a good safety reputation will receive more contracts (Bloor et al., 2013; Sampson et al., 2014). Sampson et al. (2014) describe a company manager who "was keen to change the image of the company to make sure that the safety was seen as one of the top priorities" (Sampson et al., 2014, p. 395). Regulations set benchmarks for each company's own safety standards.

However, in other parts of maritime transportation, profit equals cost reduction. It is a common view that "the cost of safety regulation is too high for the industry, because it is so extensive" (Kuronen & Tapaninen, 2010, p. 55). Some companies can prefer to run a vessel registered in a state that allows them to hire crew that accept low salaries and more work. It has been said that some unscrupulous ship owners view the ISM certificate as a piece of paper that authorizes them to continue business as usual (Bhattacharya, 2012).

Some kinds of coastal transport markets, such as general cargo, can include vessels registered in any state (Kuronen & Tapaninen, 2010). Some ship owners have been labeled unserious, uncaring, and cynical for taking advantage of the weaknesses in current regulations and choosing cheap solutions over safety (Kuronen & Tapaninen, 2010; Sampson et al., 2014). "High-standard" ship owners want the authorities to have greater power to get rid of "unserious" competitors and maintain high safety standards across the industry (Sampson et al., 2014). Charterers can also squeeze out unserious companies; they can make safety a competitive advantage if they require a high safety level when hiring ships instead of focusing on low costs (Bloor et al., 2013; Kuronen & Tapaninen, 2010, p. 53).

Facilitating working conditions on the vessels

Management of safety resources, contracts, manning, and watch schedules make onshore management a major contributor to safety-related decision making on board vessels.

During daily operations, management constantly makes short-term decisions related to profit, and such decisions can influence long-term safety on board (Fenstad et al., 2016). Schiefloe (1977) probably was the first to describe the 24-hour society on the Norwegian transport vessels, and how important the structural and social conditions were for the performance of the crew. Most governmental safety campaigns are directed at crews, but Oltedal (2011) suggests that onshore management are actually the better recipients of regulation and campaigns.

One of the primary conditions that companies set for seafarers is the contract. In contrast to Norwegian personnel, for example, crews from low-paid countries are often contracted for a single working period of several months. A new contract must be agreed upon before the next period on board. Many seafarers are afraid to lose their current job or jeopardize their next job opportunity (Anderson, 2003; Walters & Bailey, 2013). Personnel without experience with Western labor rights are willing to accept excessive working hours and poor living conditions on board in exchange for salaries that are comparatively high in their countries of origin (Silos et al., 2012, p. 857). Another negative example is the Filipino blacklisting system of individual

seafarers, causing "many Filipino seamen to accept precarious conditions of work for fear of being named in these lists, since exclusion from work can result from 'offences' such as contracting trade union representatives to report unfair treatment" (Silos et al., 2012, p. 850).

Training and working routines are also important for the ability to work safely. An analysis of UK maritime accidents points to some deficiencies in company management's facilitation of safe work (Batalden & Sydnes, 2014). The main challenges were the development of operational plans, shipboard management, and the company's inability to determine when their approaches deviated from best practices or standards. Many investigations showed that the companies had not given crew members the training, knowledge, skills, and working procedures needed to maintain operational safety.

Since fatigue is a risk factor, management decisions about watch keeping hours and organization are essential. Fatigue or severe tiredness is a common problem at sea, leading to degraded work performance (Österman & Hult, 2016). The problem of fatigue is greatest where job demands are high, there are frequent port turnarounds, extended working hours, low job support, and older vessels with noisier sleeping conditions, all of which are true in coastal transport (Smith, Allen, & Wadsworth, 2006). This is not necessarily a major issue on vessels in slow markets, since the better markets have the accelerated schedules and heightened work intensity that lead to fatigue (Størkersen, 2017; Xue et al., 2016). Fatigue can also result when new tasks have been added without adding crew, as because of overreliance on technology (Schröder-Hinrichs et al., 2016; Österman & Hult, 2016). Crew members without administrative tasks are at least as tired as personnel with a high administrative burden, so it is important to address as many aspects and tasks as possible to facilitate a safe working environment (Österman & Hult, 2016). Watch keeping should be developed together with the crews to find the best way of ensuring adequate rest in the actual onboard situation, not just in theory (Kongsvik, Størkersen, & Hansen, 2011). Oltedal and Engen (2011, p. 15) describe how fatigue, lookouts, and safe manning are all related with one another and with safety. Fatigue due to inadequate manning or watch-keeping issues regularly contributes to maritime accidents (Hetherington et al., 2006; Maritime Authority, 2015a).

Regarding manning, vessels with three or four crew members score lowest on many organizational and occupational safety variables (Nævestad, 2016). Håvold (2007, 2010) has studied the safety culture in different crews for years. He found that crews with one or two nationalities perform better than multinational crews, since that makes communication and understanding easier.

Maritime safety management systems

Companies' profit- and efficiency-focused mindset also influence how their safety management systems are developed (Oltedal, 2011). This was elaborated in a qualitative and quantitative study of safety regulations and culture in Norwegian-controlled shipping that has been published in several studies (Oltedal, 2011; Oltedal & Engen, 2010, 2011). Oltedal and Engen (2011) report that crews view procedures as a problem when they are copied from other vessels or companies or established by management after accidents, whereas the procedures can be seen as helpful tools when they are developed by the personnel themselves.

Most ship-owning companies purchase safety management systems as a commodity with standardized procedures. General safety management systems bought off the shelf have been a trend since the ISM Code was implemented (Anderson, 2003). The reasons for this approach include a lack of internal expertise, human resources demands, and the expense of developing systems internally (Christophersen, 2009; Lappalainen, 2017). These generic systems are sometimes implemented directly on an entire fleet (Bhattacharya, 2009, p. 168).

Safety management systems on vessels are in general described as extensive, complicated, and featuring procedures that are excessively detailed (Bhattacharya, 2009; Lappalainen, 2016; Oltedal & Engen, 2011; Størkersen & Johansen, 2014). The ISM Code leads to a significant amount of paperwork for both managers and operational personnel, with managers finding safety management systems difficult to handle (Lappalainen, 2016). Jense et al. (2008) found that procedures could be simplified and still meet ISM requirements, but that this understanding was lacking among ship owners. Many seafarers have believed that the ISM does not necessarily lead to safer conditions; it only requires an auditable system (Anderson, 2003). These systems tend to grow over time, since the ISM Code states they are to be "dynamic." Whenever management redesigns a safety management system, new procedures are likely to be added (Oltedal, 2010), likely because systems revisions are often externally motivated to comply with regulations (Bhattacharya, 2012; Christophersen, 2009). Top-down rules are often viewed as necessary and safer than trusting employees' judgement (Bhattacharya, 2012). Frequently, seafarers do not actually change their practices under this approach, as is explained in Section 4.4.2.

Overall, there is widespread agreement that safety management systems should be simplified, updated, and made more practical (Anderson, 2003; Christophersen, 2009; Lappalainen, 2016). The language in which they are written needs to be simple and accessible (Fenstad et al., 2016). Standardized procedures should be reduced and local adaptations should be increased, with the inclusion of input from actors at all levels (Oltedal & Engen, 2011). It is not constructive when some international crew members report that they will not get hired for the next trip if they speak out about poor safety management systems (Oltedal & Engen, 2011); instead, they and their concerns should be included in the development of the procedures. Recently, a small study about passenger vessels in the Arctic reported that managers were reluctant about the ISM code when it was implemented, but they later understood that safety management systems were largely documenting what they already knew and were doing (Kvien, 2016). These managers have a practical perspective and emphasize training in emergencies as particularly important on passenger vessels.

The relationship between company office and seafarers

For safety management systems to function, the relationship between shore management and crews must be balanced (Xue et al., 2015), with effective communication (Bhattacharya, 2009) and a management that is committed to safety (Lappalainen, 2016). The safety level on each vessel depends on safety prioritization on board the vessel itself, in combination with seafarers' interactions with ship owners and regulators (Fenstad et al., 2016).

According to Lappalainen (2016), only a few studies have evaluated maritime management's safety commitment. The ISM Code creates the basis for management to a

support local decision making on vessels, insisting that management must be committed to safety (Xue et al., 2015). Anderson (2003) observed a few well-functioning safety management systems, all in organizations that emphasized a no-blame culture. Håvold (2010) found in a study of Norwegian-owned tankers that strong management commitments to safety were vital for a positive safety culture.

Most maritime studies report a lack of trust and communication inside organizations (Bhattacharya, 2009, p. 68). The conclusion of Bhattacharya's (2009) double case study of vessels and ship owners from several countries is that managers and seafarers had fundamentally different understandings of their safety management systems. Seafarers wanted to communicate as little as possible with shore-based management, so managers instituted strict controls to ensure that seafarers were complying with procedures. Distant managers' top-down instructions about compliance bureaucratized the entire system (Bhattacharya, 2009). The personnel were offered only low-discretion roles, due to a lack of trust by managers. This is mainly what Oltedal (2010, 2011) found on Norwegian-owned tankers, leading her to urge managers to trust their highly skilled seafarers to adjust safety management systems. Top management in poor shipping companies have been found to be limited committed to safety issues (Christophersen, 2009; Lappalainen, 2016). Employer engagement correlates with safety levels on vessels (Bhattacharya, 2012). Management's focus on technical systems, statistics, and standardization is quite different from a seafarers' focus on seamanship; the two approaches should be combined (Lappalainen et al., 2010).

Two companies studied by Xue et al. (2015) aimed to balance decision-making involvement but met limited success. Interviews with managers showed little tension between shore and vessels, but the personnel on four vessels had contrasting views. The captains and crews had to follow management instructions, even though it compromised their decision making and even their safety. They felt obliged to maintain hectic sailing schedules and to accept prolonged working hours beyond legal requirements despite experiencing fatigue. The crews did not complain to management, as they saw that as useless, but sometimes they made decisions against management's wishes. Their contribution to safety management was weak overall. These conflicts in interests between management and vessel staff worsened safety practices on board. Technology has significantly reduced the distance between vessel and shore, making it easier to influence the captain, who was in some cases ordered to obey onshore management, even though the ISM Code states that captains are not to be treated this way (Xue et al., 2016).

Seafarers on short contracts are seen as particularly vulnerable, as they are in a completely asymmetrical relationship with their employers, which prevents them from speaking up for their labor rights (Bhattacharya, 2009; Lappalainen, 2016). Research, however, also shows that seafarers on long contracts are reluctant to offend their managers since that can jeopardize their future plans and lives on the vessel (Xue et al., 2016). The dangers of a non-functioning relationship are described by Antonsen (2009a, p. 1126):

> … asymmetrical power relations seem to influence on the decisions regarding when working conditions are to be considered safe enough.… The role of such asymmetries in safety-critical decisions should not be underestimated.

Positively, maritime personnel, managers, and inspectors have all expressed that communication and management's safety commitment have improved since the implementation of the ISM Code (Lappalainen, 2016). The trend shows an increasing commitment to safety from managers (Lappalainen, 2017). Many companies' management teams spend more on safety measures and see it as efficient to visit the vessels to obtain an understanding of the seafarers' real-world situations (Bhattacharya, 2009; Lappalainen, 2016).

4.3.3 Research question 2

The literature described here elaborates Table 5's criteria for company management decision making: the managers need to balance profit and comply with regulations when developing systems for their organization. Ship owners have to know the ISM Code and create safety management systems. They must also ensure that operational personnel comply with the procedures developed. As the previous section has shown, research indicates that organizations can maintain safety and resilience and offers guidance on how safety management systems should be developed. However, it also indicates that managers usually do not spend the necessary time to create the best possible systems. For example, Hale and Borys (2013a) ask whether understanding the work floor personnel is important to understand regulators and company management, and how to audit more practical rules.

The published research does not explain why so many procedures are not compatible with practical work, although knowledge of how to create adequate procedures certainly exists. The majority of management studies are concerned with how procedures are implemented or used, not about managers' decision-making criteria and constraints when they establish safety management systems. Some maritime studies, however, find that managers' intentions as to safety management systems are solely to ensure that their company and personnel comply with regulations without any concern as to whether such systems may not be practical. One obstacle introduced in some ISM studies is that general safety management systems are purchased as standardized commodities, which is diametrically opposed to both the IMO's and national regulators' intentions regarding the Code, which calls for a safety management that is practically shaped for each different vessel.

It would be valuable to know more about managers' strategies and safety-related decision making, so I include a research question about management. RQ2 is as follows:

> How is company management's safety-related decision making affected by the International Safety Management Code?

RQ2 is explored in Article B (Størkersen et al., 2017) and Article C (Almklov, Rosness, & Størkersen, 2014).

4.4 Operations

I now present literature relevant to safety-related decision making in vessel operations, generally as performed by seafarers.[13] For operations, Rosness (2009) suggests decision criteria and constraints based on earlier literature (see Table 5). Decision criteria in operations are *smooth and efficient operations* and *acceptable workloads*, while constraints are *workload* and *limited situational awareness*.[14] Experienced personnel often improvise upon a set of embodied action alternatives to make operations work smoothly (see also Klein, 1993; March, 1994; J. Rasmussen, 1997; Rosness, 2009). In the context of resilience engineering and sociology, this decision making occurs because experienced operators have internalized how to respond to normal variability in their operations and what to monitor to be able to anticipate unexpected events.

4.4.1 General research

Smoothness and efficiency

Conflicting goals form a part of many operations. Table 5 includes Rasmussen's (1997) perspectives on decision making and performance: work systems are shaped by objectives and constraints, but many degrees of freedom remain open and have to be closed by the personnel. In this discretionary space, decisions are made by criteria such as workload, cost effectiveness, risk of failure, and skills. J. Rasmussen (1997) goes on to point out how employees want to minimize effort, while management wants to minimize costs. Employees are often pushed to work quickly, even if theoretically all parties should aim for quality. Hollnagel (2009) calls this the efficiency/thoroughness trade-off (ETTO) principle. If one feels obliged to work quickly (often termed *efficiently*) instead of thoroughly, lower safety might result, which paradoxically is not efficient. This is also noted by Fenstad et al. (2016): safety is not the opposite of efficiency or profit, as efficiency is not achieved by accidents. Likelihood "of failures grow[s] when production pressures do not allow sufficient time—and effort—to develop and maintain the precautions that normally keep failure at bay'' (Hollnagel, 2009, p. 3).

The Norwegian occupational theory of the Workers' Collective shows how personnel develop their discretionary space when faced with production pressures (Lysgaard, 1961): Employee teams have informal but strict norms on how to reduce expectations and time demands from management. By always working at a comfortable pace and complying with group norms, they are able to work according to team criteria instead of being pressured from the management.

[13] Parts of many crews also function as onboard management (traditionally navigators and potentially chief engineers); they are known as officers. In Norwegian coastal cargo, most seafarers plan their own operations and have to make decisions in direct relation to regulations or company procedures.

[14] "Situational awareness is the ability of an individual to have a mental model of what is going on at any one time and to make projections as to how the situation will develop (Hetherington et al., 2006, p. 405). This is similar to what Perrow (1999, p. 318) describes as selecting a context; he discovered "the overriding importance of the context into which the subject puts the problem.… Selecting a context… is a pre-decision act, made without reflection, almost effortlessly, as a part of the stream of experience and mental processing."

Safety representatives in the oil and gas industry have been found to be trapped between regulation and organizational expectations. They are required to facilitate safety (or health, safety, and environment), but in practice struggle between assisting management or fighting for labor rights (H. B. Rasmussen, Hasle, & Andersen, 2014).

Rule compliance

Management and regulators expect operational personnel to comply with rules and procedures. Compliance is defined as decisions to act in accordance with formal safety instructions (Dahl, 2014, p. 29). Safety management systems are pervaded with compliance, even though the fact that work is done safely is mostly due to the operational personnel's skills and experience (Dekker, 2017b).

Most personnel follow rules, but rules can be overlooked or ignored (March, 1994, p. 73).[15] James Reason has devoted his career to defining performance that did not lead to the desired outcomes. Reason's (1990) human errors are "slips" or "lapses" (unintended acts) or "mistakes" (intended acts because of misperceptions or limited awareness of rules, information, situation, etc.). This can include routine or exceptional rule violations. Reason (1997) later added "mispliance," a term for unsafe behavior that nevertheless complies with "bad" rules. Rules can be undesirable to follow because they are contradictory to other rules, the context, or the decision maker's resources, competencies, or decision-making criteria (March, 1994). It may even be necessary to break a rule to get the job done (Reason, 1990). Operational personnel "may ignore cheating because rules are less designed to control behavior than to proclaim virtue," so entire groups can have informal agreements about rule breaking: "Knowing when to bend the rules is one of the hallmarks of an experienced decision maker" (March, 1994, p. 76)

Much safety literature has consistently emphasized that safety is not attained by blindly following rules (Bieder & Bourrier, 2013; Dekker, 2003; Hale & Borys, 2013a; Hale & Swuste, 1998; Hollnagel et al., 2006). One important aspect is that compliance with bad rules that do not fit the real-world situation can lead to accidents (Reason, 1997). Dekker (2017b) calls this problem the *infantilization* of personnel. The Snorre A gas leak demonstrated that rule compliance was not necessarily the safest decision criterion (Schiefloe & Vikland, 2006). A major blowout was avoided because key personnel decided not to follow the rules and leave the installation; instead, they stayed on board and used their experience to stop the leak.

Still, compliance might be the safest option if the rules are good and can be followed. A literature review of quantitative studies indicates "a positive linear relationship between safety compliance and safety. That is, the more compliance the better for the state of safety" (Dahl, 2014, p. 31).

Workload and limited discretionary space

Organizational safety researchers are concerned with how operations are influenced or constrained by an organization's upper levels and its formal structure. Vaughan (1997) shows

[15] This thesis is about how safety-related decision making is affected by regulation, but not explicitly about safety violations, compliance, or human error (as described by Dekker (2006); Reason (1990, 2008, 2013)). See Dahl (2014) and Aalberg and Bye (2017) for literature reviews and research about safety violations and compliance.

that personnel want smooth, thorough operations that comply with procedures—but that cost and time pressures result in work routines that drift away from the procedures. Such a normalization of deviance can lead to accidents, as with the Challenger space shuttle disaster. Reason (1990, 1997) also reported that high-level decisions influence the likelihood of safe operations. J. Rasmussen (1997, p. 146) stressed that any actions in an organization influence other actions, so others' actions can change the boundaries of safe behavior for operational personnel. This can result in a migration toward the boundaries of safe performance; one thinks decisions are safe and close to formal procedures, but because of informal changes in the organization, decisions believed to be safe can suddenly lead to accidents.

Newer research further elaborates how the social system in an organization shapes routines, regardless of the imposition of formal procedures. Many organizations have too many procedures that are difficult to follow, especially with a large workload, limited time, and variable conditions. When safety rules do not match the personnel's decision criteria, they need discretionary space to adapt the procedures and make decisions based on their own situations and criteria. Hayes (2012) describes a *line in the sand* that competent personnel draw to know what kind of variability can be tolerated and when one must decide to stop or choose other alternatives. Other personnel are usually confident in operational decisions made by experienced personnel who understand a situation's constraints and possibilities (Halvorsen, 2015, pp. 47-48).

K. A. Pettersen (2013) has studied aviation technicians who systematically must violate procedures to be able to act safely. Poorly fitting procedures can be a threat to safety if they are not balanced with competent personnel who can carry out abductive reasoning: to use one's own experience and knowledge of rules and the context to interpret clues in a situation and decide what to do. Routines are therefore adjusted to fit each practical situation. The organization is dependent on its personnel's competence and experience to make decisions based on abductive reasoning, which therefore "plays a considerable role, not only when things go wrong, but also when safe outcomes are produced by individual judgements and actions" (K. A. Pettersen, 2013, p. 113):

> Sometimes people may be forced to act on a hunch directly, misinterpreting or perhaps unknowingly contributing to a disaster. However, in other situations, realities clues are invaluable sources of information… leading to actions that keep systems stable and safe. (K. A. Pettersen, 2013, p. 114)

Pettersen asks why the knowledge of too many rules and the dependence on competent "rule violations" have not yet been reflected in development of safety procedures. Aspects of resilience engineering (Hollnagel et al., 2006) rely on abductive reasoning, but procedures still fail to include that approach:

> If the cognitive capacities, culture and structures that support abductive reason are systematically labelled as informal or unofficial both authorities and industries may be wrongly motivated to cut, change and constrain experiences and cultures that are essential for achieving safety in specific industries and organizations. (K. A. Pettersen, 2013, p. 115)

March (1994, p. 75) advises that "violations in the name of effectiveness are more likely when the rules are relatively rigid than when they are easily changed." Many researchers advocate a

mix of rules that fit the context and can easily change together with the surroundings, combined with enough discretionary space to develop best practices.

4.4.2 Maritime research

Normally, seafarers do their best in operations, but they are said to be hampered by bureaucracy, poor communication, lack of authority, incompatible goals, and the need to follow inappropriate procedures (Anderson, 2003, p. 276). This section elaborates on the findings of the first ISM study and other relevant research.

Cost-saving: Constraint and criterion for seafarers

Safety on board is influenced by internal crew-related conditions and external conditions involving both ship owners and regulators (Fenstad et al., 2016). Seafarers also balance the conflicting goals of safety, regulation, and profit. As in other industries, seafarers have in recent decades experienced a trend toward being assigned more tasks that are to be completed in less time and with fewer personnel: "The conditions in which seafarers work are becoming increasingly demanding. There are shorter sea passages, higher levels of traffic, reduced manning, and rapid turnaround." (Hetherington et al., 2006, p. 404). Several responsibilities have been added to the work pressure on board, without ship owners allotting more resources to the vessels (Lappalainen, 2016, p. 116); this has been accompanied by high workforce turnover (Lappalainen, 2017). Both new and remaining seafarers must work faster, have more tasks, and deal with fewer shipmates (Österman & Hult, 2016). Different types of regulation and structures require more documentation, so that the increased administrative burden is considered a risk in itself; Österman and Hult (2016) describe in some detail the issue of maritime officers' administrative tasks. These tasks can lead to stress and exhaustion, particularly because they are viewed as unnecessary and disproportionate. This constrains decision making and makes seafaring less attractive: "a whole range of administrative tasks and procedures must be undertaken by crew members, essentially outside their primary functions of ensuring safe and efficient sailing" (Silos et al., 2012, p. 857).

To ensure efficient sailing and operation is, however, both a management goal and a core part of seamanship. Both crew members and captains want to help their employer meet demands so that the company remains in business (Sampson et al., 2014). Aalberg and Bye (2017) portray how ferry companies are fined if they do not keep to their schedules. Ferry personnel have devised several strategies on how to meet schedules—rather than comply with regulations—which affects their professional competence:

> The ability to keep the schedule and not canceling a departure, are associated with high competent navigators. Being delayed, or even worse, canceling a departure, may damage the navigator's reputation both among colleagues, and at the shipping management. (Aalberg & Bye, 2017, p. 7)

The captain has formal responsibility for the crew, the vessel, and its cargo, although the company is responsible for facilitating the captain's duties. When captains are judged by their ability to adhere to sailing schedules, they experience enormous pressure (Perrow, 1999). The

captain's "decision-making power should not be constrained by the ship owner, charterer, or any other persons" (Xue et al., 2015, p. 2). Xue et al.'s (2015) study showed that the captains' decision-making power was rather limited, since it was heavily influenced by onshore management. Captains need to balance safety and efficiency and consider many factors, so any limits on their decision-making power can compromise safety. See Section 4.3.3 for more about the relationship between management and crew.

Rules constraining maritime operations

Seafarers also need to perform their operations according to rules. Rules have a dubious reputation at sea; they have often been seen as more of a constraint than a criterion or support. Rule compliance is not part of traditional seafarer competence. "Good seamanship" is described as "a blend of professional knowledge, professional pride, and experienced-based common sense" (F. Knudsen, 2009, p. 295). It belongs to a seafarer with practical and social abilities who maintains safe practices in all situations. The goal is to make wise and cautions decisions and deal with unforeseen events according to professional judgment, without being told what to do (Antonsen, 2009a). Formal rules are not viewed as a positive contribution. There are often contradictions between safety management systems and the seafarers' traditional competence (Aalberg & Bye, 2017; F. Knudsen, 2009; Kongsvik, Antonsen, & Størkersen, 2014). One seafarer, interviewed by Antonsen (2009b, p. 1123), underlines the inconsistency between informal and formal work ideals:

> That expression, 'good seamanship', it doesn't exist anymore, because everything that is to be done, has to be written on a list. You are not supposed to use good seamanship and common sense, you are supposed to use check lists, procedures and maintenance lists. That's what it's all about. And I know this is a source of great annoyance to the guys on the deck.

Instead of making decisions based on rules, seafarers use their professional competence to select decision criteria. A new study by Aalberg and Bye (2017, p. 3156) shows that not even a third of Norwegian ferry personnel surveyed "always follow procedures." The authors find procedures to be decoupled from the work practices on board. Operations are performed using skills and experience, not procedures (Aalberg & Bye, 2017; Bhattacharya, 2012). Rules are perceived as the opposite of common sense, experience, and the professional competence of seamanship (Bhattacharya, 2009; F. Knudsen, 2009). Detailed procedures lead the seafarers to feel as if they are being "treated like children" (Oltedal & Engen, 2011, p. 10). They think that their employers do not believe that they have any competence or that the company just wants to lay blame in the event of an accident (Aalberg & Bye, 2017; Oltedal & Engen, 2011; Størkersen & Johansen, 2014).

The intentions behind the ISM Code included changing the negative view of rules by favoring practical and locally developed safety management systems. However, from the earliest implementation of the ISM Code, seafarers have expressed resistance (Anderson 2003). Safety management systems are seldom perceived as legitimate, since seafarers see many of the procedures as of low quality and view themselves as more competent than the personnel who developed the procedures (Antonsen, 2009a). The systems usually define operations that everyone knows, whereas seafarers want procedures for difficult operations or when problems

arise (Bhattacharya, 2012). Too much focus on procedures can also cause elements not explicitly covered by the safety management systems to be overlooked (Jense et al., 2008).

The state of the procedures does not always make it possible to comply. There is often a gap between the written procedures and how safe work is actually done (Bhattacharya, 2009). Many companies have standard safety management systems that are not tailored to specific vessels and activities (Bhattacharya, 2009, 2012; Oltedal & Engen, 2011). In many cases, this makes maritime safety procedures too numerous, detailed, and distanced from actual operations (Bhattacharya, 2012; Lappalainen, 2016). For some situations, there is more than one procedure, but there are too few crewmembers to perform all tasks (Aalberg & Bye, 2017; Størkersen & Johansen, 2014). Oltedal and Engen (2011) use Snook's (2000) term *practical drift* to explain the discrepancy between the local situation and the standardized procedures. When procedures are not tailored to operational needs, they become difficult to comply with. On some ships, safety management systems have been either a "paper mountain" or "a dead letter" that is not followed at all (Lappalainen, 2016, p. 25). Bhattacharya's (2009) study of the ISM Code in international waters found that seafarers saw it as bureaucratic and instead did their tasks according to practical criteria. Afterward, in fear of sanctions, they tried to mask the work they had done to make it appear as if they had indeed followed the rules.

Many studies report a feeling of stage acting, as when checklists are completed *after* a watch instead of during the work (Lappalainen, 2016). This leads seafarers to view many safety procedures as "a charade" (Oltedal & Engen, 2011, p. 12). Paperwork takes the focus away from working safely (Bhattacharya, 2012); officers can spend several hours every week filling out forms.

Reporting non-conformities is not very common in the maritime industry (Lappalainen et al., 2010), although some sectors are better than others. For example, liquid tankers have more substantial safety management systems and better reporting practices than dry cargo vessels (Oltedal & Engen, 2010). The charterers who hire these tankers play a role in this difference.

Successful regulatory influence on seafarers

Much of the above research depicts a situation far from the intentions of the ISM Code. The IMO wanted the Code to lead to continual improvement of practices and procedures and, consequently, the development of an organizational safety culture (Kongsvik et al., 2014; Lappalainen, 2008, 2016; Oltedal, 2011, p. 15). Several conditions have been shown to interfere with the ISM Code's influence on operational decision making (Fenstad et al., 2016).

Still, positive changes have been reported in some studies. International data reveal a reduction in accident frequency among ships after the ISM Code was implemented (Knapp & Van de Velden, 2011). Among the studies of onboard work, many positive results come from recent studies involving Nordic ship owners and some smaller companies, in contrast to the negative aspects presented above.

The ISM Code makes shipping companies responsible for vessel safety. Some studies find that crews use the ISM Code to obtain the safety measures they want from their employers (Fenstad et al., 2010; Lappalainen, 2016; Sampson et al., 2014). Offshore support vessel crews

were mainly positive about the ISM Code, since it made their companies focus on safety (Fenstad et al., 2010).

A major study of Finnish shipping supports other research indicating that the ISM Code and safety management systems have brought more systematic "safety thinking" on board (Lappalainen, 2008, 2016; Lappalainen et al., 2014; Lappalainen et al., 2010). One captain labeled the ISM Code as that rare regulatory reform that has actually resulted in safer work. Systematic safety management might have improved seafarers' safety competence and culture; this has also been discussed in the Norwegian context by Fagerholt, Kongsvik, and Størkersen (2014); Størkersen, Bye, and Røyrvik (2011). Training is now taken seriously and has become routine (Jense et al., 2008). In 2010, Lappalainen found improved safety attitudes and less resistance to safety management (Lappalainen et al., 2010). Among the seafarers he interviewed, safety management was considered essential and beneficial, and none saw the ISM Code as unnecessary. The crews appreciated that safety issues were present in their organizations at all times. However, the crews were not in favor of increased documentation and wanted to be more engaged in creating procedures (Lappalainen et al., 2010). More studies report fewer problems of excessive safety management systems when personnel is integrated into decision-making processes (Lappalainen, 2016; Oltedal, 2011).

Crew participation

Some procedures are perceived as useful, especially those for high-risk operations (Aalberg & Bye, 2017). This is an important factor that operational personnel know by heart. The seafarers' skill in high-risk operations can be—and in some companies is—used to involve them in the development of safety management systems (Aalberg & Bye, 2017). Procedures could be closer to the work as actually done if seafarers were a regular part of system development (Lappalainen, 2017). Many rules are disliked or ignored because seafarers feel alienated by them (Bhattacharya, 2009). Personnel are more likely to commit to and comply with safety management systems they have helped develop (Lappalainen, 2016). Seafarers have experience and knowledge that can make the safety management systems more useful. This is not emphasized in the original ISM Code (Bhattacharya, 2009), but it is a feature of the Norwegian Ship Safety and Security Act that ratified the ISM Code (Norwegian Ship Safety and Security Act, 2007).

With crew participation, aspects like procedures, incident reporting, and documentation could become more useful. Antonsen (2009a, p. 1126) finds that an "efficient safety management system is created in the interplay between aspects of culture an aspects of structure."

4.4.3 Research question 3

The literature described in this section elaborates the criteria and constraints relevant to safety-related decision making at the operational level (see Table 5). The operational personnel want smooth operations that are easy, quick, and ideally thorough, but they are at the mercy of their upper echelons' decisions, resources, and rules.

When the IMO created the ISM Code, they intended it to increase safety on vessels by seeing that seafarers had safety management systems tailored to their specific situations. Instead, safety management systems are now perceived as distanced, theorized, bureaucratized, and an obstacle to safety-focused work. Rule compliance is challenging to achieve when procedures are difficult to obtain an overview of, are contradictory, or are ill-suited to the operation, personnel's decision criteria, and the like. The personnel must consider multiple factors and adapt procedures in the light of their own situations and decision criteria. Competent employees know what kind of variability can be tolerated and where to draw the line in the sand, but they do not always have the discretionary space or resources to make decisions according to their own criteria.

It is important to know more about the seafarers' safety-related decision making, so I include RQ3 about operations:

> How is operational personnel's safety-related decision making affected by the International Safety Management Code?

RQ3 is explored in Article C (Almklov et al., 2014) and Article D (Størkersen, 2012).

5 Methodology

The data in this thesis consist of qualitative field studies and interviews with 83 people in the Norwegian maritime industry. In addition, I rely on the information and previous research reported in Chapters 2–4. In this chapter, I describe the operationalization of my research questions, the methodological starting point, the selection of informants, the methods used, and how the data were analyzed; I also discuss my choices in terms of method. As is common in methodological texts (Coffey & Atkinson, 1996, p. 146), this chapter is a retrospective reconstruction. The research project's research questions and methods were well planned, but empirical conditions turned the data gathering into a pleasant, if occasionally bumpy, ride.

5.1 Research design

To answer the overall research question and the three specific research questions, it was necessary to conduct a sociological, qualitative, abductive, and explanatory case study.

Ontologically, the thesis is based upon sociology and social constructionism, since I developed the research questions out of a view that groups of actors' decision making will be influenced both by formal regulation and organizational and societal conditions. Epistemologically, the thesis has an empirical foundation. The research questions are developed partly with knowledge from publications by, for example, Lindøe, Baram, and Renn (2013); J. Rasmussen (1997), and Antonsen (2009c).

This study can be characterized as a multiple-case case study with subunits. The cases are from Norwegian coastal cargo and passenger transport on different levels, with subunits from different companies and areas. Case studies are recommended when the research question is a "how" or "why" question and researchers have little control over a contemporary phenomenon to be studied in real life (Yin, 2003, p. 1), meaning that relevant behaviors cannot be strategically manipulated and the boundaries between the phenomenon and its context are not clear. The cases offered me the opportunity to find in-depth answers to the research questions in the context of the actual environment of the relevant actors. Case studies can deal with several types of evidence, documents, artifacts, and methods; in this thesis, interviews and observations are the primary type of evidence.

The study is explanatory; my cases are studied to explain how the ISM Code influences safety-related decision making among both the studied actors and a wider set of seafarers. However, the rich data involving coastal transporters on different levels and in different sectors that are described in Articles A–D give this thesis a descriptive angle as well.

In terms of design and reasoning, this thesis is abductive (Coffey and Atkinson (1996, pp. 155-156). Abductive studies have a dynamic interaction between data and theory, in contrast to inductive theorizing based on empirical descriptions and deductive empirical theory testing. Abductive reasoning is a part of many decision-making processes, including those of my informants, so it is discussed in Section 4.4.1, using the research of K. A. Pettersen (2013).

Earlier research and theory was in mind in the development of the project, research questions, method, and interview guide; I focused on the field during data gathering and initial interpretation, and focused on theory in the rest of the analytic process. Data categories and codes were determined partly based on theory and earlier research (Bieder and Bourrier (2013); Hollnagel et al. (2006); J. Rasmussen (1997)), but primarily from empirical descriptions. I have explored all the data over many rounds so as not to omit anything and to determine how the categories relate to the data, earlier research, and theoretical ideas, as recommended by (Coffey & Atkinson, 1996, p. 46). In this sense, it is a strength that the data gathering and publication processes lasted several years.

It is also worth noting that the type of research I have done is mostly *applied*, because the research results are used in companies, and partly *policy research*, since the results are intended to influence policy-makers (Guthrie, 2010, p. 5); see more in next section.

The three research questions are discussed in four articles (see also Table 1):

A. Størkersen, K. V. (2015). Survival versus safety at sea: Regulators' portrayal of paralysis in safety regulation development. *Safety Science*, *75*, 90–99.
B. Størkersen, K. V., Antonsen, S., & Kongsvik, T. Ø. (2017). One size fits all? Safety management regulation of ship accidents and personal injuries. *Journal of Risk Research*, *20*(9), 1154–1172.
C. Almklov, P. G., Rosness, R., & Størkersen, K. V. (2014). When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge? *Safety Science*, *67*, 25–36.
D. Størkersen, K. V. (2012). *Fish first: Sharp end decision-making at Norwegian fish farms. Safety Science*, *50*(10), 2028–2034.

5.2 The informants in RESCUE and Aquaculture

Data from two research projects are included in this thesis (see Table 7). The main data collection was carried out in 2011–2013 as part of the research project Regulative Rationalities and Safety Culture Development (RESCUE), but some dates back to 2008 during the study Aquaculture and Intelligent Transport Systems (Aquaculture).

Table 6: Number of interviewees divided by project and level/research question

	RESCUE (2011–2013)	Aquaculture (2008)	Total per level/RQ
RQ1. Regulators	21		21
RQ2. Management, including one interest association	19		19
RQ3. Crew	32	11	43
Total interviewees, all levels			83

The data from these three studies offer insight into different situations in different parts of Norwegian coastal transport over a significant period of time. The studies are presented below in greater detail.

The RESCUE project

The RESCUE research project is the basis for my PhD scholarship. Articles A–C are based on RESCUE data. The overarching research question in this thesis is derived partly from the RESCUE project description that was formulated by Trond Kongsvik, Stian Antonsen, and our research group. I have developed the three specific research questions further with insights from gathering data and reviewing the literature.

RESCUE was funded by the Research Council of Norway from 2011–2015 and consisted of research partners SINTEF Technology and Society, SINTEF Fisheries and Aquaculture, Safetec Nordic, and NTNU Social Research. This large project included studies of how regulatory and industry institutions cooperate to maintain safety and a safety culture in Norwegian cargo and passenger transportation. The sectors studied are maritime coastal cargo and passenger transportation and freight railway transportation. They have been studied through observation, interviews, and surveys designed especially for each industry sector and organizational level.[16] The project manager was Trond Kongsvik, while data collection was carried out by Trond Kongsvik, Jørn Fenstad, Rolf Bye, Petter Almklov, Stian Antonsen, Randi Ann Fagerholt, Jens Petter Johansen, Jørgen Gullestad, Knut Torsethaugen, Gudveig Gjøsund, Gunnar Lamvik, and me. I was central in developing interview guides, planning data gathering, and conducting analyses; I was also the interviewer in a majority of the interviews, usually accompanied by at least one of my colleagues.

Table 6 is an overview of informants based on level, while Table 7 lists informants based on sector. The industry actors studied in RESCUE are a selection of small-, medium-, and large-sized transport companies all over Norway. In the maritime sector, there were interviews with 18 employees at 3 coastal cargo companies and on their Norwegian-registered vessels and 28 interviews at 2 passenger transport companies and on their high-speed craft. The different number of respondents in the sectors illustrates that it was easier to reach high-speed craft employees, since this industry consists of fewer companies that are more centralized and have more employees, while coastal cargo companies are smaller, more widely distributed, and heterogenous. Regulators were also interviewed: on the maritime side, we interviewed a total of 21 representatives from the Norwegian Coastal Administration, the Maritime Authority, and four counties. In addition, we interviewed 5 representatives from a central interest association.

The Aquaculture project

The Norwegian aquaculture industry's need for intelligent transport solutions was analyzed in the Aquaculture project in 2008. That project was funded by the Research Council of Norway, with research partners including SINTEF Fisheries and Aquaculture, Rambøll, and NTNU Social Research, in addition to industry and governmental partners. Researchers from several fields employed a wide range of research methods. NTNU Social Research's contribution was a qualitative study of organizational safety aspects of fish-farm operations. With my colleagues

[16] The railway study and the surveys are not used as this thesis' data material, but publications about them are referred to and support the interview-based maritime findings. The response rates in the surveys were 59 % for coastal cargo, 58 % for passenger transport, and 40.4 % for freight rail. For descriptions in Norwegian about these studies of passenger, cargo, and rail transport, see Antonsen and Ekle (2014); Fagerholt et al. (2014); Fenstad, Kongsvik, and Størkersen (2012); Gullestad (2013); Kongsvik and Johansen (2013).

Jørn Fenstad and Tonje Osmundsen, I participated in operations and then interviewed fish farmers and other personnel, such as divers who washed nets and seafarers on live fish carriers who transported the fish or on general cargo vessels that took fish fodder to and from the fish farms.

In the Aquaculture project, we interviewed 44 people and observed 55 people at 7 fish-farms and on 3 vessels in the central and northern parts of Norway (Fenstad, Osmundsen, & Størkersen, 2009). See Table 6 for an overview of informants based on level and Table 7 for informants based on sector.

Since the data were gathered to understand how operations were performed and what safety-related equipment the personnel needed, the personnel's safety-related decision making was discussed thoroughly in both interviews and during observations. Later, I wrote a research article about two transport operations, illustrating the fish farmers' and seafarers' safety-related operational decision making (Article D). Formally, only seafarers work under the ISM Code, so only the 11 seafarers on live fish carriers and general cargo vessels were included in the data for this thesis.

Table 7: Data material used in this thesis, divided by sector and project details

Sector	Interviewees	Year	Project	Financed by
Coastal cargo	11 seafarers on 3 vessels from 3 companies	2008	Aquaculture and intelligent transport systems (Aquaculture)	The Research Council of Norway
	16 seafarers from 5 vessels from 3 companies, 2 company management representatives 5 people at 1 interest association	2013	Regulative rationalities and safety culture development (RESCUE)	The Research Council of Norway
Passenger vessels	16 seafarers from 5 vessels at 2 companies 12 company management representatives	2011 and 2012		
Regulators	Coastal Administration: 4 representatives Maritime Authority: 13 representatives Counties: 4 people in 4 counties			
Totally	83 people			

5.3 Research strategy

In all three projects and on several levels in cargo and passenger transportation, the basic method was interviewing, with observation serving as an important support. In the reporting in the four articles, the interview data are particularly visible, since I use quotations to show the actors' views.

As a first step of data collection in each project, we contacted organizations with potential informants by telephone. They were informed orally and in letters sent via email about the project and how the data would be gathered, depersonalized, stored, and used. All employers and informants gave informed consent before participating in the project. The same procedure was executed across all projects. All data were collected and treated according to ethical research guidelines and Norway's Personal Data Act. As required, the projects' data collection was reported to the Norwegian Centre for Research Data.

Interviews

The interview is the most important kind of source in this type of study; the interviews revealing the most information were often guided conversations that featured a fluid stream and asked the right questions (Yin, 2003, pp. 89-90). My interviews were semi-focused and semi-open-ended; we usually indicated that we wanted one-hour interviews and had an interview guide with questions. I use "informants" rather than "respondents" because participants offered not only their opinions but also more information about the topics, their safety management systems, the industry, other actors to meet with, and where to find more information.

Each interview was a semi-structured research interview in the informants' workplaces. Some interviews were with groups, while others involved one person. One, two, or three researchers performed each interview. We had interview guides with prepared topics and questions that functioned as reminders about discussion points and possible formulations that could provide useful information for our research. The aim was to have each interview flow like a balanced conversation, covering topics that the interviewee saw as important for the project's research questions. Most interviewees liked this format, and it provided substantial information about their everyday work and its context in the maritime industry.

Interviews are verbal reports (Yin, 2003, p. 92) by people who know their situation. On the positive side, they provide information about research questions through detailed descriptions of the situations and phenomena under study. On the negative side, there is the possibility of informal manipulations, biases, poor recall, inaccurate articulation, traditions, and culture resulting in pressures or obligatory responses. Therefore, we used several techniques to overcome workplace politics and the weaknesses of the interview format. We tried out different questions, talked to different people, spent time with each person, and after a while found out what provoked them, what they debated, and what the reasons behind their thoughts actually were. The interviews were recorded and transcribed by my coworkers and me.[17]

Observation

Observation has also been a valuable means of obtaining an understanding of each actor's and level's casual interaction, environment, challenges, and opinions. Informal direct and partly participatory observation on field visits was useful in providing additional information about how the informants talked with each other, worked, lived, and ate, as suggested by Yin (2003).

The quality and depth of our observations varied on the different levels and with the different actors. At the regulators' offices, there was virtually no observation; we made a presentation about our project and talked briefly with the representatives before the interviews, in addition to having informal conversations during lunch, meetings, and so on.

The situation with company management was similar, although more varied. Some of the contact was on the telephone or email. We also sometimes stayed several days to conduct a sufficient number of interviews with management and to sort out the details for the researchers' field trips on the vessels.

[17] The audio and text files were stored on a safe server. We never recorded the names of the informants. During transcription, the transcriber also converted names or specific expressions into more generic terms or blank fields.

On the vessels, on the other hand, observation was the *primary source* of information in all projects. We generally spent two intensive days and nights on each vessel, working with the personnel, relaxing with them on breaks, during meals, and in their limited spare time. We did conduct formal interviews, but we also had several other conversations that helped shape our understanding of the industry, decision making, and our research projects. The observation technique tended more to participant observation, as we not only talked to and observed the crews, but also tried to help out with their tasks and even tried them ourselves (Yin, 2003). We got to know the crews, their work, their views of the industry and other actors, and completely unrelated topics like their family lives. This was highly valuable for me as a researcher, as it supplied a substantive problem for the thesis, the ability to understand the problem deeply, and some insights into how to begin solving it. Especially on the vessels, the method applied was ethnographic in the sense of close, direct, detailed observation of the natural conditions of the studied actors (Yin, 2003). I also made every effort to meet all cases without a prior commitment to any specific theoretical model, as is essential for ethnographic research, even though the literature and previous research was the basis for the project descriptions.

5.4 Analysis

To transform the data from the everyday worlds of the informants into research results that would say something about the wider phenomena in my research questions, the data were analyzed and interpreted (Coffey & Atkinson, 1996). They were categorized into patterns and explanations from which the theorization was conducted.

The interwoven process of data gathering, reporting, and analysis

Comprehensive searching and systematic scrutiny were essential in the interwoven process of analysis (Coffey & Atkinson, 1996, p. 191), which was part of every stage of the project. We certainly had dialogue "with the data, with ideas, with informants, with colleagues, with oneself" (Coffey & Atkinson, 1996, p. 191). Some analysis had already started in the planning process, but I describe below how the actual data were analyzed during and after data gathering.

During fieldwork, I discussed the interview guide topics and the data with informants, both alone and with my colleagues. My coworkers and I wrote field notes. Analysis came naturally when transcribing and listening to the interviews. Some interviews were fully transcribed verbatim, but for most, only the most relevant parts were transcribed while the remainder was summarized. In some ways, the most important analysis happened when the relevant interview portions were written down, because this is when the first decisions about relevance were made. The data were already *reduced* to some extent at this point; they were then *displayed* as transcript files (Coffey & Atkinson, 1996). During the work with the transcripts, categories in the data material appeared.

The data and categories were analyzed in project group meetings. Interview files and field notes of the cases were compared and discussed to find differences and similarities

according to our pre-understanding, the literature, and the empirical findings. We used analytic computer software tools (Nvivo and some HyperRESEARCH) at the start of the RESCUE project, but did not see any benefits as a result. We searched manually for stories and metaphors in the data without doing a complete narrative analysis. This approach made us aware of common knowledge, shared understandings, situated realities (Coffey & Atkinson, 1996, p. 86; Sohlberg & Sohlberg, 2002), and especially myths related to the ISM Code and its regulators. This was valuable for interpretation and the category and pattern making described in the next section. Analytic ideas were proposed, and more data analyzed to test the validity of those ideas. During the project meetings, the reporting of the data and results were also planned.

All results were communicated in reports, papers, a book, newspaper articles, and presentations at academic meetings and conferences. Some publications were largely descriptive, while others presented ideas and arguments further removed from the empirical data. The general data material in each case study was described in reports (Fenstad et al., 2009; Kongsvik & Johansen, 2013; Størkersen et al., 2011, etc.). Some papers served as first analyses (Kongsvik et al., 2014; Nilsen & Størkersen, in review; Størkersen, 2015a, 2017; Størkersen & Johansen, 2014) and served as the basis for Articles A–D. However, for each text or presentation we went back to the field notes and interview transcriptions and re-analyzed the relevant data. In the publications, the authors described the empirical data in their own words, in addition to using quotations from the interviews, to illustrate the opinions of groups of interviewees. This approach shaped the empirical results section of each article, which was the basis for its discussion. The empirical results section of each publication was initially very large and was reduced after several rounds of analysis, discussion, and weighing of the data's most important aspects. The data were thus *reduced, displayed*, and *interpreted* (Coffey & Atkinson, 1996, p. 7) in many rounds during the writing of each publication. These different versions of the texts and presentations and the many rounds of analysis carried out during development of the publications constituted a significant part of the analysis in this thesis as a whole.

Patterns and explanations

The previous section shows that the results were found through categorizing and finding patterns in the empirical data. We collected examples of relevant phenomena and tried to find commonalities, differences, patterns, and structures (Coffey & Atkinson, 1996, p. 29) by coding and organizing the data into "components to reveal their characteristic themes and patterns" (Coffey & Atkinson, 1996, p. 8). This part of the analysis was both data *reduction* and data *complication*: "Coding generally is used to break up and segment the data into simpler, general categories *and* is used to expand and tease out the data, in order to formulate new questions and levels of interpretation" (Coffey & Atkinson, 1996, p. 30).

We categorized the patterns of the topics that many interviewees discussed, agreed or disagreed with, or that were controversial to the informants, such as procedures, tasks, resources, and time pressure. These categories or codes were primarily based on the empirical descriptions, but were also inspired by theory and earlier research (Bieder & Bourrier, 2013; Hollnagel et al., 2006; J. Rasmussen, 1997). We focused our analysis on organizational conditions, but environmental conditions such as the market and economy were also factors.

Only conditions that the informants emphasized were included in the analysis. The patterns were discussed, contextualized, and compared to one another and earlier research.

My further use of the patterns can be labeled *explanation building*, as described by Yin (2003); this approach strives to define a predicted pattern before data collection, but my colleagues and I were not explicit about this. We had some thoughts about the links, since many studies had analyzed how safety regulation influenced managers and personnel in various ways, often at the expense of hands-on safety work (Antonsen et al., 2008; Bhattacharya, 2009; Bieder & Bourrier, 2013; F. Knudsen, 2009; Lappalainen et al., 2014; Oltedal, 2011; Vandeskog, 2015, etc.). To build explanations, one must find causal links that explain the relationship between certain variables, such as how the ISM code influences safety-related decision making. "In most studies, the links may be complex and difficult to measure in any precise manner," but any missing accuracy can be compensated for with iterations (Yin, 2003, p. 120). To illustrate the analysis employed in this dissertation, I cite as an example how deck and navigational operations appeared to be affected differently by the ISM Code (the main finding of Article B). Other studies had emphasized that ISM and related procedures constrained onboard personnel's decision making (Anderson (2003); Bhattacharya (2009, 2012); Oltedal (2011), but our data were more favorable about ISM, since our informants on all levels indicated that ISM affected their decision making positively *and* negatively. We also were aware of the paradoxical statistics of increasing ship accidents and decreasing personal injuries in the time period during which the ISM code was implemented (see Figure 4). We thus looked more closely at the data and at the positions of the informants and found different consequences of the ISM Code for deck operations and navigation. Even though we did not have a predicted pattern or explanation beforehand, we were still surprised by these findings, so we delved into those aspects and discussed rival explanations, contradictory theories, and counterarguments.

The validity was maintained through careful considerations of the findings and research process in relation to the practical field, earlier research, and the full range of potential methodical choices. Still, it is important to note that many of the findings—such as the explanation of different ISM influences or paralysis in safety regulation development—should not be called conclusions, but rather *suggestions* for further research and discussions.

Theorizing

Theorizing means to build theories, concepts, or ideas in a dialogic relationship with analysis and data. Coffey and Atkinson (1996, p. 163) argue that "qualitative data, analyzed with some attention to detail, understood in terms of their internal patterns and forms, should be used to develop theoretical ideas… that have relevance beyond those data themselves." Abductive reasoning makes it possible to move from specific conditions to generic levels:

> Abductive inferences seek to go beyond the data themselves, to locate them in explanatory or interpretive frameworks.… There is thus a repeated interaction among existing, ideas, former findings and observations, new observations, and new ideas. (Coffey & Atkinson, 1996, p. 156)

I have compared my empirical data with previously developed theory and found theoretical propositions that go hand in hand with analytic generalization (Yin, 2003). Here, my years of

experience in research in this field were valuable. We had earlier research and theory in mind in the development of the overall project, research questions, method, interview guide, and in the last rounds of the analytic process. We analyzed the data in the light of theories of many kinds. My data material about each of the crews and companies was organized, compared, and discussed according to its categories and earlier research, so I am confident that it can provide valuable insights about other crews and transport companies operating on the Norwegian coast. I found data that were able to "to transcend the local settings of [my] primary data collection in order to generalize to a wider range of social domains" (Coffey & Atkinson, 1996, p. 144). In addition, theorizing is interwoven into the analytical process and cannot be divorced from it (Coffey & Atkinson, 1996, p. 140). There was a constant interplay between our data material and my ideas for results and papers.

My theorizing was mostly done to explain possible ISM influences on decisions by the actors on different levels (the overall research question) and how these are interrelated. The thesis can be understood as explanatory, which as (Coffey & Atkinson, 1996, p. 143) suggest, is valuable with "detailed, qualitative research in uncovering the complex causal relationships at play within given social milieux." Our fieldwork has uncovered much about how safety-related decision making in Norwegian coastal transport has been affected by the ISM Code.

Practical implications

Some of our articles include direct suggestions for change that can be implemented with some feasible adjustments, while other results simply point at problems upon which policymakers should act. Some of the findings might lead to a changed focus in future academic texts, hopefully toward a simplification of administrative tasks and auditing that keeps in mind that the ISM Code also has benefits for safety under certain circumstances.

However, the work done parallel with scientific publication has led to changes on other levels. The Aquaculture project led to attention being paid to health and safety in aquaculture operations, by both companies, regulators and researchers. The RESCUE project results have led the Maritime Authority, counties, and even certain politicians to take action to improve safety-related issues in coastal transport procurement processes. Politicians have started processes in parliament to maintain safety in governmental procurement. Groups advocating passenger transport company cooperation to simplify rules and navigational tasks have also been established by the Maritime Authority, Road Administration and a national group of passenger transport companies. Several research projects funded by the Research Council of Norway's transport programs have further elaborated on the findings in the RESCUE project.

5.5 Scientific quality

There are several ways to demonstrate that a qualitative sociological abductive case study has high scientific quality. This text has already provided some information about the research questions, field, method, data gathering, and analysis. To discuss the quality of the study design

systematically, I now address the project's relation to Yin's (2003) four conditions of scientific quality: construct validity, internal validity, external validity (generalizability/ transferability), and reliability.

5.5.1 Construct validity

Construct validity is about establishing the right measures for the concept studied (Yin, 2003, p. 34). As described earlier in this chapter, I have tried at all times to choose the correct operational measures for this study. I have deliberately chosen the data for this thesis, even though I was involved in the gathering of information from more informants, positions, organizations (in the rail sector), and have used questionnaires in both the rail and maritime sectors. Therefore, it is valuable to discuss several decisions related to the method: the choice of qualitative data (not quantitative, which we also gathered); maritime industry (not railways, for which I also have data); division of informants in each group; to use data from two projects.

The choice of qualitative methods

Interviews and observation were chosen as the best ways to indicate how safety-related decision making is affected by the ISM Code. Stories from the affected actors themselves explain how they interpret their situation and the relationships between the Code and other regulatory and environmental influences.

Lappalainen (2016) discusses different methods to assess maritime safety culture in Finland; he chose qualitative methods to understand the inner life in shipping organizations. He interviewed and observed 15 crews, their company management, several pilots, and representatives of governmental bodies. One aspect of his discussion is not applicable to my study: he had difficulty accessing deck and catering personnel interviews, since they did not have time to be interviewed during working hours. My coworkers and I, on the other hand, had no problems obtaining access to all crew members, likely because the vessels and their crews were small, making it natural for everyone on board to talk to each other. Small vessels and crew sizes are characteristic of the Norwegian coastal fleet. This might also have made it easier for me to carry out a more thorough observation of the decision making, sometimes by being able to participate in the work (see descriptions in Section 5.3).

The choice of the maritime industry

This thesis is focused on qualitative data from the maritime industry. Coastal cargo and passenger transport is both under-researched and relatively prone to accidents, so a thorough study of this sector is intriguing and important. I chose to focus on *one* industry to be able to go in detail regarding its safety management regulation, the work the regulation is supposed to monitor, and the practical influence it has on different parts of the industry. I had a great deal of data from the maritime industry and already knew it well though multiple research projects over the last decade.

Choice of division of informants in each group

Regarding the selection of interviewees, there are empirical reasons for gathering more data from the cargo sector than the passenger sector and more data from seafarers than representatives from other levels. The data material includes 21 authority representatives, 18 managers, and 43 seafarers (Table 6). Furthermore, Table 7 displays that the data contains 28 informants from the passenger sector (both seafarers and managers) and 34 from cargo. I argue that these are natural proportions, as there are fewer personnel at the higher decision-making levels, while there are fewer seafarers working on high-speed craft. Norwegian passenger vessels are relatively few in number and have similar activities, regulations, and subsidies. The sector is therefore much more standardized than the fragmented and heterogeneous coastal cargo sector. In the Norwegian-owned cargo industry, there exists a large number of seafarers of all nationalities on different vessels working under a variety of flags and other conditions. The coastal cargo sector can be divided into at least three subsectors—bulk, general cargo, and live fish carriers (see Chapter 2 and Article D). To obtain a thorough enough understanding of the decisions in cargo transportation, it was necessary to have a dataset featuring a broad range of seafarers.

However, the data from the management level could certainly have been more varied. On the positive side, in examining Articles B and C (answering RQ2), I am confident that the data from managers are deep and wide enough to give a valid result. We interviewed safety managers, operating managers, purchasing agents, administrative directors, and ship owners, in addition to five representatives from different parts of a large and central employer association for around two hours each. However, on the negative side, when I discuss environmental stressors that influence safety management regulation or compete with regulation in influencing the actors' decision making, I see shortcomings in the topics included in the interviews with the managers. The in-depth interviews about safety in the industry, safety regulation, facilitation of safety on the vessels, cooperation with regulators and seafarers, organizational and economic limitations and priorities, and so on, were not quite enough to paint a thoroughly detailed image of how the managers were influenced by these different market stressors. This would have been valuable to know more deeply, but since it is not directly part of the thesis scope, I regard these data as acceptable for the purposes of this thesis.

Choice to use data from two studies

It proved valuable when discussing problems and benefits to supplement the thesis with data gathered some years ago, so some of the cargo data is from 2008.

One reason for employing data from both projects is the already stated complex nature of the cargo sector, but to select data carefully from existing material and to combine data from two projects can be problematic. I argue that the topics and methods of these projects were comparable and that the selection therefore is both practically and ethically acceptable. The 11 earlier informants gave their informed consent in that project, which posed similar research questions. They consented to provide us with their knowledge about how they perceived their work, its context, safety measures, and the decisions made by them and the actors around them. They also consented for their data to be anonymously communicated, synthesized, and

published through texts, oral presentations, etc., without any deadline. The similar research questions and methods made it possible to integrate the data from the earlier informants with the data from the more recent project.

However, if I had interviews with only the ISM Code in mind, I could have conveyed a greater stress on all parts of the ISM in my dealings with the informants. For example, it is possible that a greater emphasis on certification and supervision could have provided a complementary understanding about how decision making is affected by the ISM Code. Control in the form of auditing is a large part of function-based regulation, including the ISM Code. The authority level is in charge of oversight and expressed their ideas about needed improvements during interviews that we discussed in Articles A–C. How certification and control explicitly influence company management and seafarers and how it can be improved might have been better understood if I had delved more deeply into the actors' experiences with auditors and inspectors or interviewed personnel from recognized organizations. In the semi-open-ended interviews, the issues of control and supervision arose frequently. The informants did not describe all control processes, indicating instead that their decision making was heavily influenced by its potential to be audited.

It is useful with data gathered under other circumstances—in the three research projects—to obtain a variety of perspectives. Moreover, it is useful to have data with a wide time span. How and why questions "deal with operational links needing to be traced over time, rather than mere frequencies or incidence" (Yin, 2003, p. 6). The time gap in this thesis appears unproblematic, as the data gathering phases in 2008, 2010, and 2013 all reveal similar contexts and are related when it comes to topics, views, and descriptions of the cargo industry. Over that time frame, the Norwegian government changed three times, but maritime and trade policies remained virtually unchanged (Norwegian Cabinet, 2005, 2009, 2013). Communication with maritime actors in 2017 indicates that contemporary conditions are very comparable. Therefore, the long time period largely confirms that the observed results draw a picture of today's Norwegian cargo industry, rather than only being applicable to a specific context for a very limited period of time, area, or market state. Due to the dependability of governmental politics (see Article A), the data from the regulators in 2011 and 2012 should still be valid.

5.5.2 Internal validity

Since this thesis strives to explain the relationship between safety-related decision making and the ISM Code in Norwegian coastal transport, I must consider spurious relationships. Internal validity is about establishing the right causal relationships (Yin, 2003, p. 34). In the interviews, the informants described how their decision making related to their working conditions and the ISM Code. In well-considered decisions—such as safety routines under the supervision of the authorities, companies' safety management development, and personnel's risk considerations—it is possible to explain to a degree how the ISM Code influenced those decisions. In other decisions with less extensive prior thought, such as "taking shortcuts," it is not easy to identify what led to a decision. Furthermore, no matter how a given decision was made, the safety management systems stemming from the ISM Code include many procedures that are not necessarily rooted in the ISM, but might be implemented because of liability law,

culture, misunderstanding, or other factors. I discuss these issues at several points in this thesis and in Størkersen (2017).

When looking at the decision-making processes as a whole to find the influence of the ISM Code, I also found other influences and how they interact with the Code's influence. For example, regulators' discretionary space is limited by political and industrial interests working together. Business and the values of costs and legitimacy or accountability work together with ISM Code audits to create enormous safety management systems and thus several negative unintended effects of the ISM Code. This is easier to see when analyzing decision making in its entirety, not just the parts that can be expected to be influenced by the ISM Code.

Thus, I have addressed the major rival explanations and used the best methods to investigate what I wanted to investigate, I have emphasized the most relevant aspects of the data, but I cannot say that my findings determine precisely how safety-related decision making is affected by the ISM Code in its pure form, because societal phenomena such as accountability and economics will influence both the ISM Code's enforcement and related decision making.

In further studies I would include a comparative perspective, such as other transport sectors, industries, or types of regulation, or by using other methods and disciplines. Only through a robust comparison of safety management regulation in other industries or countries can we understand the potential of Norway's maritime safety management regulation to influence the actors in other ways than it does now. A larger survey involving other regions and including factors other than regulation, such as trade policies, industry characteristics, and the power of actors, could offer additional insights into what regulation can influence and when it is largely influenced by other factors.

5.5.3 External validity

It is preferable for a scientific study to give knowledge about something more and beyond its immediate case study (Coffey & Atkinson, 1996; Yin, 2003, p. 37). The goal in qualitative research is to generalize the findings to a theoretical proposition rather than a specific population (Yin, 2003, p. 10). Abductive thinking is a valuable means to transfer or expand data. I have described my theorizing and abduction in Section 5.4.3.

Earlier research, media reports, and the actors' responses indicate that my findings could well be relevant beyond Norwegian coastal transport, as, for example in terms of proceduralization, safety regulation paralysis, and the economic priority involved in the decision making on several levels in many countries and segments of society.

Most actors in Norwegian coastal passenger and cargo transport will recognize the situations described in this thesis. Our data describe the situation in the northern, central, and southern parts of Norway's coast from 2008–2013, with informants from all over the country and abroad. Other Norwegian studies generally paint the same picture (for example Bye et al., 2012; Håvold, 2010; Lindøe, Engen, & Olsen, 2011; Nævestad, 2016; Oltedal, 2011; Soma, 2004b; Vandeskog, 2015). Even the oldest data does not appear to be out of date. Recent contact with industry actors and data gathering in new projects both indicate that the conditions are similar in 2017. There are no signs that either safety regulation or the context in which they are supposed to operate will change radically any time soon.

The international maritime community, or at least European coastal transport, appears to operate within conditions similar to the ones elucidated in this thesis. Low economic margins are common for small- or medium-sized ship owners, and it is common to minimize manning. It is also common to assign many administrative tasks to navigators, and that seafarers have resistance against rigid procedures. Some of my findings therefore appear to describe certain decision-making criteria and constraints in contexts studied in international maritime research (Bye & Lamvik, 2016; DeSombre, 2008; Heij, Bijwaard, & Knapp, 2011; F. Knudsen, 2009; Lappalainen, 2008; Piniella, Silos, & Bernal, 2013; Smith et al., 2006; Walters & Bailey, 2013; Österman & Hult, 2016).

In addition, some of my findings might contribute to understanding certain elements of decision making and regulation influence in other industries. At the very least, my analysis shows that is valuable to discuss and rely at least partially on the findings of studies in other industries dependent on safety management regulation or organizations in general (Antonsen, 2009c; Bieder & Bourrier, 2013; Hohnen & Hasle, 2011; Hopkins & Hale, 2002; Lindøe, Baram, & Renn, 2013; Røvik, 2011, and many more). Whether some of my results are transferable to another specific industry depends on how a given industry's characteristics, politics, and structures relate to the relevant parts of Norwegian maritime reality. Almost all organizations seem to experience negative sides of accountability, the audit society, bureaucracy, internal control and self-regulation. The problem analyzed in this thesis could therefore be relevant to many areas and serve as a backdrop for similar struggles in several industries.

5.5.4 Reliability

Reliability is about demonstrating that the data gathering could be repeated with the same results. In qualitative research, this largely involves to describe the data gathering and all parts of the project so thoroughly that any reader could understand what has been done and how the findings and conclusions were reached (Yin, 2003).

In this thesis, my research process and analysis are well documented. I have tried to describe every step of the process in this chapter, documenting much of the analysis in field notes, meeting memos, and numerous versions of the various texts that make up or are related to this thesis.

Moreover, my coworkers and I acknowledge that there is "no such thing as pure description, as it takes a human observer to accomplish description" (Coffey & Atkinson, 1996, p. 9). Therefore, we have been very conscious of our role in the data gathering, analysis, interpretation, and communication of the results. We have (re)constructed the descriptions and formulated our findings carefully and humbly. The results might be flavored by the persons interviewed, but the number of interviewees should be enough to eliminate individual bias and show an overall pattern for Norwegian coastal transport.

It would be tremendously interesting to see what other researchers might find if they took exactly the same approach to the same type of groups, whether in Norway or in another country.

6 Summary of research

This chapter consists of résumés of the articles that constitute this thesis. Four articles report the research results for this thesis, Articles A–D (Almklov et al., 2014; Størkersen, 2012, 2015b; Størkersen et al., 2017). The complete texts are attached in Appendix II. These articles are described briefly here to give an impression of the empirical results that form the foundation of this thesis before the findings are discussed in Chapter 7. Some sentences are direct transcripts of the article abstracts. The titles of the subsections describe which part of the Norwegian coastal maritime industry a given article treats in terms of the relevant decision setting in Table 5. How the articles answer the research questions is discussed in Chapter 7, but a short overview is presented in Table 8 at the end of this chapter.

6.1 Article A: Maritime regulators (cargo and passenger)

Article A, *Survival versus safety at sea: Regulators' portrayal of paralysis in safety regulation development* is about maritime regulators' safety-related decision making.

The background for the article is a question about how maritime regulation relates to other maritime framework conditions. Safety regulation has the potential to decrease the frequent accidents found in sea transport, but aspects of the existing regulations are also found to contribute negatively to safety. Earlier research suggests that other framework conditions influence maritime safety more than regulation (O. F. Knudsen & Hassler, 2011; Walters & Bailey, 2013), but do not review the relation between the maritime context and regulators.

The data for Article A are interviews with Norwegian maritime regulators and facts about other actors (i.e., politicians, shipping companies, interest groups, and the media) in the maritime transport arena. The theoretical foundation is safety and decision-making theories. A general summary of the findings in Article A reveals that a form of paralysis is currently constraining safety regulation development. Despite wanting a safe industry, maritime actors are obliged by competition to disagree about the priority of safety versus profit, which hampers safety regulation development and constrains regulators and their discretionary space. Many of the decision criteria with which regulators must comply are forced upon them by others, so that regulators see them as constraints. Safety regulation is further weakened when market forces influence both making and enforcing regulations. The findings demonstrate that political actors usually do not prioritize safety over other goals in practice; they must take many considerations into account. Safety often loses out in conflicts between safety and economy. However, making safety a priority could elevate maritime transport above the choice between safety or survival.

6.2 Article B: Regulators, managers, and seafarers (passenger transport)

Article B, *One size fits all? Safety management regulation of ship accidents and personal injuries*, was written with Trond Kongsvik and Stian Antonsen. The topic is how regulation influences safety management practices in the prevention of different types of accidents.

The background for the article is that safety management regulation is an important supplement to market forces in establishing a sufficient level of safety in high-risk industries. In Norwegian maritime passenger transportation, accident statistics are paradoxical: personnel injuries have decreased, while ship accidents have increased during the period since the ISM Code was enacted in the late 1990s.

The data for Article B consist of interviews with Norwegian maritime regulators, ship company management, and crewmembers on passenger vessels about their practices and opinions regarding safety management regulation. A general summary of the findings accentuates earlier research showing that regulation serves to raise the bar by heightening industry levels of safety investments and organizational safety awareness. In addition, our results suggest that safety management regulation in maritime transport is mostly effective at preventing personal injury, at least in cases where personnel have sufficient time and resources available and procedures are consistent with seafarers' professional values. In ship accidents such as groundings, on the other hand, the negative consequences of regulation (proceduralization and administration) and external conditions both take the navigator's concentration off the safety-critical task of navigation. This may offer some explanation of why personal injuries have decreased and ship accident frequency has continued to increase, in spite of regulations aimed at improving safety.

6.3 Article C: Companies and seafarers (cargo and passenger)

Article C, *When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge?*, was written with Petter Almklov and Ragnar Rosness. Its starting point is that knowledge generated by safety scientists may displace or marginalize existing local or system-specific safety knowledge embedded in operational practices. The text is based on the literature about relationships between knowledge and power, complemented by organizational theory on standardization and accountability.

The data material are case studies from the railway and maritime sectors. The analysis shows that an increased reliance on self-regulation and international standards in safety management may be drivers of a shift in the distribution of power regarding safety, changing the conception of what constitutes valid and useful knowledge. In both the studied sectors, we observed discourses based on generic approaches to safety management and an accompanying disempowerment of the practitioners and their perspectives. We discuss certain contributing

elements to this development, such as the roles of external and internal health and safety specialists and the increased importance of international standards. We propose that the search for broad generalizations and widespread adoption of cybernetic thinking in safety science may resonate with societal trends toward standardization and bureaucratic control. We conclude that safety scientists, safety professionals, and organizations that hire safety professionals need to be sensitive to the possibility that their well-intentioned efforts to promote safety may lead to a marginalization of local and system-specific safety knowledge.

6.4 Article D: Operational personnel (cargo)

Article D, *Fish first: Sharp end decision-making at Norwegian fish farms*, explores criteria and constraints for decision making in sharp-end operations at fish farms. The background is that aquaculture operations are very prone to accidents but are scarcely described in the research literature.

The data are interviews and observations of 55 people in 12 aquaculture companies and 11 seafarers on 3 well boats from 3 companies. Two common situations with risk of loss are described and analyzed. The first is net cage damage discovered during feeding, which creates the challenge of managing both the planned tasks and the necessary modifications or repairs. The second situation arises when a well boat crew must get the fish to the harvesting plant, but the weather is bad, forcing them to decide how to balance their assigned tasks, time pressure, and unstable and possibly dangerous conditions.

In Article D, I find that management relies on operational personnel to make all safety decisions in the operations for both their biological product and themselves. The operational personnel often neglect personnel safety in favor of product safety. Even though criteria and constraints largely coincide with theory and are similar in the two analyzed operations, the personnel safety outcome is different. In daily operations, there is a major risk to the operational personnel, while in the rare well boat operations the best conditions for the fish also prevent personnel harm. When dealing with a biological production process, ordinary safety measures are inadequate, because when activities need to be done at exactly the right time for the product to be profitable, personnel safety comes second.

Table 8: Overview of how Articles A–D answer the research questions

Article A *Survival versus safety at sea: Regulators' portrayal of paralysis in safety regulation development*	Article B *One size fits all? Safety management regulation of ship accidents and personal injuries*	Article C *When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge?*	Article D *Fish first: Sharp end decision-making at Norwegian fish farms*
General research question: How is safety-related decision making in Norwegian coastal transport affected by the International Safety Management Code?			
The regulators' safety-related decision making is affected by the ISM Code, but other decision criteria are a larger part of the decision making than the regulators would prefer.	The ISM Code influences the decision criteria of regulators, management, and operational personnel. However, the documentation requirements and co-regulation also constrain safety-related decision making (see below).	Provides an understanding of how safety management regulation moves safety-related decision making toward standardized criteria, at the cost of more flexible practical criteria.	Safety management regulation does not necessarily influence decision making regarding personal safety, if other criteria (such as product welfare or profit) are regarded as more important or suitable.
RQ1: How is regulators' safety-related decision making affected by the ISM Code?			
Norwegian regulators contribute to making regulations in international organizations through politicians. The regulators have strong decision criteria involving ISM compliance. Still, in daily enforcement and decision making, they are influenced by their political superiors and industry actors to make decisions according to trade-driven criteria.	Co-regulation obliges regulators to leave much of the power and decision making to company management. The regulators cannot decide exactly how or what companies' safety management systems will be. The regulators also have problems following their own criteria because of the constraints imposed by global regulation and national politics.		
RQ2: How is company management's safety-related decision making affected by the ISM Code?			
	Company management's decision criteria are influenced by the ISM Code, which leads managers to make safety investments and hire safety consultants. However, managers take measures that they might not see as useful. Their typical response to their safety responsibility often results in procedures that put significant documentation demands on vessel personnel.	Management is affected by safety management regulation in several ways: when acquiring safety management systems, management use decision criteria of profit making and staying out of trouble. Under this rationale and the logic of safety management regulation and accountability, it seems useful to purchase compliant systems rather than design one for the company.	
RQ3: How is operational personnel's safety-related decision making affected by the ISM Code?			
	The Code affects seafarers' decisions differently: safety management systems give common seafarers safety awareness and routines, which might decrease personal injuries. The systems also give navigators and local managers too many tasks and constrain them with heavier workloads, which impacts their onboard concentration and situational awareness, which can contribute to ship accidents.	Companies often implement safety management systems that are too complicated and general for practical decision making. The procedures marginalize seafarers' decision criteria. Regulations tilt safety-related decisions toward criteria of compliance and documentation and the constraints of increased workloads.	When goals are contradictory in safety-related decision making, the criterion of taking care of the live product trump safety management regulation. Procedures influence safety-related decision making more if they fit with the actors' actual situations and decision criteria.

7 Discussion of the ISM Code's influence on decision making

This chapter demonstrates how the findings in this thesis and reported in Articles A–D contribute to an understanding of the problem addressed. First, each research question is discussed to show how the ISM Code influences each level in both intended and unintended ways. The findings on each level then supply a foundation to discuss the ISM Code's overall influence and how some contributing conditions lead to unintended effects.

7.1 Influence on regulators' decision making

RQ1 is about how regulators' safety-related decision making is affected by the ISM Code. Articles A and B reported the relevant findings. The data are from Maritime Authority representatives, since they translated the ISM Code and implemented it into Norwegian law, as approved by political actors, and are obliged to enforce the Code. I begin by describing the key findings about their safety-related decision making in general before briefly analyzing the influence of the ISM Code.

7.1.1 Safety criterion constrained by the characteristics of the ISM Code

Most authority representatives interviewed would prefer that their decision making depended entirely on the ISM Code's core value of safety. This fits with all the decision criteria for the administrative support functions from Rosness (2009) and shown in Table 5: compliance, consistency, and optimizing a single attribute. The regulators are eager to work for safety on the vessels and to influence companies to establish effective safety management systems.

Some characteristics of the ISM Code ironically complicate this desire. It is common for function-based rule sets to give companies the responsibility for safety, safety management systems, and internal oversight that is supplemented by external supervision by regulators or recognized organizations.

The authority representatives find function-based rules to be complicated to manage, (also found by Batalden and Sydnes (2014); Lindøe, Baram, and Renn (2013)). All auditors follow guidelines but complete their inspections based on their own judgements, as described by Aae and Heggøy (2013). Regulators depend on the trust of, information from, and cooperation with industry to enforce function-based regulations (Baram & Lindøe, 2013; Bratspies, 2009; Walters et al., 2011). The data in this thesis demonstrate how regulators effectuate their reviews with traditional means.

One relevant constraint variable noted in the decision-making literature is "limited hands-on knowledge" (Table 5). The regulators interviewed were not comfortable with the fact that the content of the safety management systems was out of their hands (Articles A and B). The regulators have no role in deciding how and what companies' safety management systems will be, as they are obliged to leave much of the power and decision making to company management. This limits regulators' ability to influence the industry as much as they would like, especially when companies adopt other measures and set safety levels lower than desired.

7.1.2 Safety criterion constrained by political business values

In addition, regulators are constrained by instructions from politicians. For example, the Maritime Authority has been given the overarching goal of being an attractive authority for ship owners, even as they are supposed to monitor safety in the companies and on board their vessels. The regulators do get to implement some safety measures as instructed, but not as much as they would like. Politicians—and many of the interviewed authority representatives—want ship owners to flag their vessels in the Norwegian registers. Without vessels registered in Norway, Norwegian regulators would have no influence at all.

The same rationale is given as a reason why Norwegian regulations by and large should not deviate from the international regulations (Article A). The regulators also have problems following their own criteria because of the constraints inflicted by global regulation and national politics (Articles A and B).

Instead of making new regulations according to their own criteria, the regulators implement and enforce international regulations. In some countries, it is common to talk about regulators as if they do not have enough practical experience or knowledge to formulate the regulations (Johnson, 2014; E. Roe, 2013). In my interviews, Maritime Authority representatives were frustrated that they seldom had the chance to demonstrate that they could craft very useful regulations. The improvement of safety regulations is paralyzed both nationally and internationally, so the regulators do not have the tools to regulate safety as they wish (Article A).

In daily enforcement and safety-related decision making, regulators are also influenced by their political superiors to make decisions according to business criteria, which is valued by both politicians and companies. This makes profit criteria just as common a factor as safety and regulation in the regulators' safety-related decision making.

7.1.3 ISM influence on authority representatives

The Maritime Authority representatives' main decision criterion is the same as the ISM Code's main value: safety. This criterion is preferred in all decisions about regulation development, implementation of safety management systems, and auditing the systems that exist. At the same time, the Maritime Authority has been directed by its ministry to emphasize industry values, with its explicit goal of being "the preferred maritime administration." The authority representatives interviewed generally see themselves as constrained by commercial values and the characteristics of the functional rule regime. Their discretionary space is limited by the ISM Code in terms of safety priority, which they value as positive. It is also limited by the ISM

Code's requirements of verification and certification, obliging them to oversee the systems but not their content, which they experience as negative for their safety-related decision making.

7.2 Influence on company management decision making

RQ2 addresses how company management's safety-related decision making is affected by the ISM Code. Articles B and C report these findings. The ISM Code states that ship-owning companies are responsible for safety in their activities and must establish safety management systems that are internally and externally audited.

The main management criterion is to maintain a sustainable business, which necessarily makes profit a priority, but also includes compliance with regulations and safe operating standards. This is parallel with two criteria in Table 5: *ensure commitment or compliance* and *avoid trouble*. The findings are similar in the cargo and passenger sectors, although some differences are noted in the text.

7.2.1 Combining criteria of compliance and profit

Regulation's task is to influence safety decision criteria in companies whose primary concern is profit (J. Rasmussen, 1997; Reason, 1997; Walters et al., 2011). The ship-owning companies in this study report that they must balance expensive safety measures and profit. Price is practically the only competitive argument in passenger transport procurement (Gullestad, 2013) and in obtaining cargo transport assignments (Lindøe, Engen, & Olsen, 2011; Sampson et al., 2014; Størkersen et al., 2011). It has been found that low cargo rates lead to more accidents in sea transport (Soma, 2004b). Article B shows that the ISM Code influences the decision making so as to sometimes favor safety investments instead of saving costs and making a profit. Some managers even take measures that they may not see as useful (Article B).

Most of the company managers interviewed perceived that they had sufficient safety measures and emphasized that the economic margins in maritime transport are so small that they cannot afford to implement more than demanded in terms of oversight. This is contrary to how co-regulation is intended to work, with companies presumed to have the expert knowledge of what kinds of safety measures they need for their particular operations (Baldwin et al., 2011; Baram & Lindøe, 2013).

Budget is also a major decision criterion when companies are developing or purchasing safety management systems (Article C). This relates to the *satisficing* decision-mode. Instead of developing tailor-made safety management systems—which demands time, people, and other resources—most companies buy pre-made safety management systems that more or less match their activities. As a result, they often end up with an unwieldy system that is designed to cover all eventualities, activities, and situations, and thus with a number of procedures that do not fit the situations on their vessels. It is very easy for the simple function-based ISM Code to be followed by detailed safety management systems and company bureaucracies. Anderson (2003); Christophersen (2009); Lappalainen (2016); Oltedal (2011) all describe the purchase of easy-to-audit, off-the-shelf safety management systems that are not adapted to specific vessels'

activities. However, price is not everything. Researchers have for years urged simplified safety management systems, but organizations have not found the approach that will achieve this goal (Bieder & Bourrier, 2013; Grote, 2012, 2015; Hale & Borys, 2013a, 2013c; Lappalainen, 2017). A lack of resources appears not to be the only reason why most safety management systems are so extensive.

7.2.2 Criterion and constraints of accountability

Ship-owning companies' compliance with the ISM Code has proven to differ in practice from how compliance was envisioned by rule makers and regulators, and perhaps by management and seafarers as well. Many safety management systems are larger and less practical than they are compliant (Articles B–D).

A more profound reason than budget might be that companies are supposed to be carefully monitored under the ISM Code, using both internal and external audits: they must demonstrate their accountability. Again, the ISM Code's safety values are constrained by the Code's demands of documentation and oversight, which makes managers emphasize safety management systems' auditability in line with business traditions (Hood (2007, 2011); Power (1994, 2004)).

The criterion of auditable systems leads to the purchase of generic, standardized safety management systems that are guaranteed to satisfy the ISM Code, other regulations, and liability demands at the same time.[18] Article C points to how the rationale for safety management systems is driven by the decision criteria of profit-making and staying out of trouble. Under this rationale and the logic of ISM's audit demands and accountability trends, it appears worthwhile to company management to seek support on how to implement compliant systems. Consultancies are hired to help companies become safe and legitimate, allowing managers to cover their backs (Hood, 2011). Moreover, the same consultancies that sell auditable safety management systems are also those that are trusted to inspect and propose sanctions of those same systems. This is outsourcing of both regulation development and regulatory enforcement to the same parties, which can give the impression of the fox guarding the henhouse (Baram & Lindøe, 2013, p. 51).

Management purchases auditable safety management systems and consultants because they are constrained by their own limited information processing capacity. They lack adequate knowledge of regulations and the ISM Code (Articles B and C), which can lead to the impression that safety management systems should be more advanced than what is described in the ISM Code. In practice, extensive systems are never really implemented because many of their prescriptions are too general, abstract, and de-contextualized. In the words of organizational theorists like Czarniawska and Sevón (1996); Røvik (2011): adoption processes are decoupled, the systems are shallowly entrenched in order to comply, but the process that should have involved contextualization to create relevantly transformed and replicated safety systems instead turns into standardization. In theory at least, these general and unusable safety management systems should not protect companies from liability issues either, since the systems are not fully implemented. The lack of practical systems can hamper usability, trust

[18] Mechanisms explaining standardization is explained in Almklov and Antonsen (2010, 2014), and liability/accountability issues are explained in Baram and Lindøe (2013) and Power (2004).

from the personnel, and the overall resilience of the organization (Grote, 2009; Hollnagel et al., 2006).

By contrast, the few companies that do develop their own useful safety management systems by using their seafarers as in-house consultants end up with systems that are equally legitimate, inexpensive, and much more practical; these firms also implement blame-free cultures (Anderson (2003); Christophersen (2009)). Still, most maritime safety management systems are created far away from seafarers (Bhattacharya (2009); Lappalainen (2016); Oltedal (2011)), and this study shows that might be largely due to an emphasis by company management on auditability.

7.2.3 Potential improvements of maritime safety management

Ship-owning companies are still not off the hook. There is some room within the ISM Code to let safety goals have more influence, with less focus on auditing. Even in the current situation, managers can simplify safety management systems a great deal, reduce documentation, ask seafarers to help develop safety measures, and transfer administrative tasks from the vessels to the shore. The work associated with documentation can be reduced by implementing comparatively inexpensive technology. Pre-existing data from electronic voyage plans, the engine room, logbooks, and satellite navigation can be used in reports. Some documentation take non-written forms, such as video-recorded work or audio recordings of meetings, provided such surveillance is better than spending time on writing documentation.

Management can try to build a resilient organization to facilitate safety-related decision making that favors trust, discretionary space, and competence over more rules, blame and blame avoidance, and blind compliance. Operational personnel can be engaged to offer more feedback about the actual use of safety management systems. This will demand effort and an innovative spirit, but it has been shown to be possible (Dekker (2017b).

7.2.4 ISM influence on ship-owning company management

The managers interviewed in this study reported that their safety-related decision making was heavily influenced by the ISM Code. The Code makes them implement safety management systems and safety measures that they would have forgone without the Code. However, the audit demands in the ISM Code are the focus of these managers. Accountability, auditability, cost saving, and the traditions to solve them make managers purchase management systems that are not customized for their activities.

Thus, the managers' discretionary space is limited by the ISM Code in terms of both safety and supervision. However, their discretionary space for safety-related decision making is actually wider than what the managers demonstrate with their present decision making.

7.3 Influence on operational personnel's decision making

RQ3 addresses how operational personnel's safety-related decision making is affected by the ISM Code, with the findings about seafarers reported in Articles B–D. For seafarers, the ISM Code is most commonly encountered in the safety management systems they have onboard and are supposed to comply with. Procedures in the safety management systems are the form that the ISM Code takes when it reaches the sharp end after being transformed by regulators and management as organizational directives (Czarniawska and Sevón (1996); Røvik (2011). Safety management systems include procedures for operations and planning, routines for training and risk assessments, task and maintenance plans, and so on.

7.3.1 Balancing costs, efficiency, and safety as decision criteria

The main decision criteria for the seafarers in this study are smooth and efficient operations and acceptable workloads (see Table 5). It is common to interpret the personnel's wish for efficiency as a desire to save themselves time and effort, as opposed to the efficiency that the employer wants (Hollnagel, 2009; Lysgaard, 1961; J. Rasmussen, 1997). However, the data in this thesis demonstrate that onboard personnel genuinely want to be efficient and profitable for both the sake of the company and their professional pride (Articles B–D). For example, product welfare and service continuity are regarded as nothing less than essential (Article D). The same determination, loyalty, and occupational pride have been reported in other studies (Aalberg & Bye, 2017; Sampson et al., 2014; Thorvaldsen, 2017). In the present study, the efficiency/thoroughness trade-off is also observed (Hollnagel, 2009). Some of the seafarers, especially in passenger transport, reported being explicitly pressured to work faster than their professional experience suggests is wise, as Xue et al. (2016); Xue et al. (2015)). Anderson (2003) found that seafarers try to do their best, but their performance is hampered by bureaucracy, poor communication, and incompatible goals.

To choose between safety and trade is the most common and critical decision in the operational decision setting (Amalberti, 2013), especially since many vessels operate with fewer staff and more demands than was true previously (Hetherington et al., 2006; Lappalainen, 2016, 2017; Silos et al., 2012; Österman & Hult, 2016). Cost saving is thus both a constraint and a criterion, for the seafarers in my study and in previous literature.

7.3.2 Seafarers following procedures: Constraints or potential

For the seafarers in this study, compliance is a term with mostly negative associations, generally because of the poor conditions connected to compliance with safety management systems.

Compliance is often seen as a constraint, partly because it involves competencies other than those commonly found among seafarers. Many seafarers in this study referred to "old seamanship, in which a seafarer was to be practical, social, and safety conscious in all situations (Antonsen (2009a)). Articles B–D elaborate on earlier findings that written procedures are sometimes viewed as the opposite of common sense and seamanship (Anderson (2003); Bhattacharya (2009); Christophersen (2009); F. Knudsen (2009); Røyrvik et al. (2015);

Vandeskog (2015)). Some compliance can only be achieved by personnel with skills in administration, rules, and reporting. As a result, the ISM Code has changed the seafarer groups' competence and culture (Fagerholt et al., 2014; Lappalainen, 2008; Størkersen et al., 2011). Experts with theoretical perspectives can marginalize traditional seamanship (Article C).

Crewmembers in this study stated that procedures do not take variability into account, and hamper them in skill- and knowledge-based decision making. Most crewmembers in Norwegian coastal transport have tasks for which they are responsible; the navigator does not instruct them on a daily basis. Rule compliance can make personnel less equipped to handle situations outside the norm (Antonsen et al., 2012; Power, 2004), because handling variability demands practical competence, training, and discretionary space (Størkersen & Johansen, 2014). Given the inherent variability of maritime operations, seafarers simply must have discretionary space. Safety-related decision making can involve skill, rules, or knowledge-based decision making (J. Rasmussen, 1997). If knowledge-based decision making is required, the personnel need to create space for abductive considerations on how to safely complete an operation (Hayes, 2010; K. A. Pettersen, 2013).

If procedures and situation do not match, regulations do not affect the decision making as intended; instead, the personnel make room and decide according to their own criteria (Article D). This is stressed by, for example, Hale and Borys (2013a) and described empirically by Bhattacharya (2009). A mismatch is shown to result in practical drift aboard tanker vessels (Oltedal & Engen, 2011). March (1994, p. 74) foresaw this non-compliance scenario over 20 years ago when he predicted that "violations of rules due to inconsistent demands will increase as rules multiply and become more complex, where devices for coordination are weak, and where independent regulators have the right to impose rules." Regulation has the most influence when it leaves some discretionary space for the operational personnel.

7.3.3 Safety management systems: Positive for some, not for others

The ever-increasing demands for documentation and procedural decisions are described in the safety literature as *bureaucratization* or *proceduralization* (for example Bieder & Bourrier, 2013; Dekker, 2014; Hale & Borys, 2013c; Lindøe, Baram, & Braut, 2013; Rosness, 2013). The bureaucracy included in safety regulation can, ironically, add risk to the operations (Antonsen et al., 2012; Dekker, 2014; Walters & Bailey, 2013). Sometimes it is necessary and widely agreed upon to break a rule to get the job done (March, 1994; Reason, 1990). Extensive procedures and documentation can divert attention from key decision-making processes (Articles B–D). All occupations in the study underlined a wish for less documentation and administration, in line with the findings of Österman and Hult (2016).

To understand how the ISM Code influences operational personnel, it is useful to analyze personnel with different tasks. The data in this study show that safety management systems affect operational decision making differently in different operations. While procedures can influence the decision making during navigation negatively, they can be translated into positive resources in the decision criteria used in crew operations.

On the positive side, most informants in this study are content with some routines, and the ISM Code is seen as a positive contribution that has improved decision making in areas like systematized routines, emergency training, maintenance, familiarization, watch-keeping

schedules, and reporting of unconformities and safety investments, to some extent. This is mostly consistent with reports by Jense et al. (2008); Lappalainen (2016); Oltedal (2011). For operational personnel without administrative roles, the safety routines are positive. In loading and discharging operations, for example, safety procedures may add to the workload, but only in terms of the planning or debriefing of an operation, which can actually make the operation as a whole go more smoothly. A focus on safety management systems can provide the crew with more systematic safety knowledge and the company with more safety measures, which broadens situational awareness and can reduce the constraints of safety-related decision making. Seafarers have become aware of the connection "between the procedures and the risks they are meant to reduce," as Dahl (2014, pp. 88-89). In many onboard operations, the administrator (navigator or captain) says what to do and how to do it, so the procedures are translated for the crewmembers, who do not need to worry directly about compliance (Lappalainen (2016); Lappalainen et al. (2014) have found many of these positive conditions. By contrast, studies such as Bhattacharya (2009) and Anderson (2003) report that subordinate personnel have to do all the translation from theoretical procedures to practical work themselves.

Still, the documentation tasks almost always fall on the navigators, the local administrators in charge of the vessel. (Most coastal vessels in Norway operate without chief engineers.) This reality is present in all the articles in this thesis, but most explicitly discussed in Article B. Documentation and administration of sailing, cargo, and personnel increase workload and decrease concentration and situational awareness during navigation, as also described by Hetherington et al. (2006); Österman and Hult (2016). Some earlier maritime research touches upon the special constraints and responsibilities of ship officers (Bhattacharya & Tang, 2013; Fenstad et al., 2010; Xue et al., 2016; Xue et al., 2015). The challenges described include communication with and meeting the demands of the crew and onshore management. Navigators commonly experience a pressure to maintain tight schedules (Aalberg & Bye, 2017; Perrow, 1999). One of my findings that has not received substantial attention is the *translation* of requirements between shore management and seafarers. Navigators are core personnel, and the decision criteria for them are virtually the same as for the rest of the crew – and at the same time they are local managers. Earlier research does not seem to have made the distinction between operational personnel with and without administrative duties, and the different benefits and constraints they obtain from proceduralization.

In summary, ordinary seafarers are not as exposed to the pressure to produce or to negative procedures as the navigators, as long as navigators make sure to give the seafarers this discretionary space. My data, like Lappalainen (2016), show how important the administrative tasks are, so at least someone can enjoy the benefits of the ISM Code. This distinction provides valuable insight that may shed light on why personal injuries have decreased and ship accidents increased in Norwegian coastal transport over the last decade (Figure 4). This shows the importance of practical rules, or alternatively, excellent local work administration.

7.3.4 ISM influence on seafarers

Seafarers are mainly influenced by the ISM Code through management's safety investments and safety management systems. A large part of their decisions and tasks are influenced by

those systems. Thus, the seafarers' discretionary space is limited by the ISM Code, leading to both positive and negative results.

It is positive for discretionary space that safety awareness and safety routines exist as a result of the ISM Code. Similarly positive results have also been found in Swedish and Finnish shipping (Jense et al., 2008; Lappalainen, 2016). I find that the occupational group that enjoys these positive effects most is the everyday operational personnel without administrative tasks who have a captain or coordinator that translates the tasks and procedures and takes care of the documentation.

It is negative, however, that procedures might still play too large a role in many seafarers' decision making. On the Norwegian coastal transport vessels in my study, many seafarers of all professions reported finding some procedures to be poorly fitting and effectively impossible to follow. Still, it is primarily the navigators who bear the negative extra workload, such as substantial documentation, increasing administration, communication, and other responsibilities delegated by the onshore office.

7.4 Safety management gone astray

The results of Articles A–D shed light on question of how safety-related decision making in Norwegian coastal transport is affected by the ISM Code. The Code requires companies and vessels to have safety management systems and documentation, including procedures for safe work and maintenance, reporting, training, and so on.

7.4.1 Translation of ideas through Rasmussen's socio-technical system

As with all organizational ideas, safety management regulation is transformed through all the influenced levels in both its development and its implementation (see Figure 5 by J. Rasmussen (1997)) and descriptions of organizational ideas by, for example, Røvik (2011) and Kongsvik (2006)). We must accept that regulations to prevent "hazardous processes" will go through translations at every level of implementation. It is equally important that the translation is bound to be influenced by the environmental conditions, which Rasmussen calls environmental stressors. Regulation trickles down the chain and travels up the chain again after implementation; the higher levels are affected by the lower levels' safety-related decision making and how they deal with regulations on their level. There is implicitly a loop in every hazardous process. In Article C, the loop continues when we discuss how safety science is developed from data that originates in the sharp end, then translated and turned into regulations or other safety measures that trickle back down from the blunt end to the sharp end.

Figure 5, created by Rasmussen in 1997, still has value and can explain much of today's maritime safety management. Articles A–D describe the decision making of the actors on most of its illustrated levels and how many of the environmental conditions influence them and the implementation and translation of regulations.

Rasmussen's (1997) original figure does not state which actors are at the governmental level. Thus, it cannot be criticized for excluding the international legislative structures.

However, when I use this model to illustrate the coastal transport system (Figure 2 in Chapter 2) I add an international level to illustrate the key role of supranational regulation.

The data in this thesis show that regulators and associations are on the same level in many ways, since recognized organizations control compliance on behalf of the Maritime Authority and develop rules for their audits. In common safety research, one usually divides authority/regulator, company management, and operational personnel. I follow this approach in the three specific research questions in this thesis, with each question examined at a specific level. The analysis, however, has demonstrated that Rasmussen's levels of company, management, and staff are, in fact, more accurate. Operations consist of personnel with very different tasks and decision settings, so it is useful to treat onshore management, navigators, and crewmembers as three different levels.

Rasmussen's figure has provided a significant framework to combine the literature about regulation, decision making, safety management systems, accountability, and organizational ideas when analyzing the ISM Code's influence on Norwegian coastal transport.

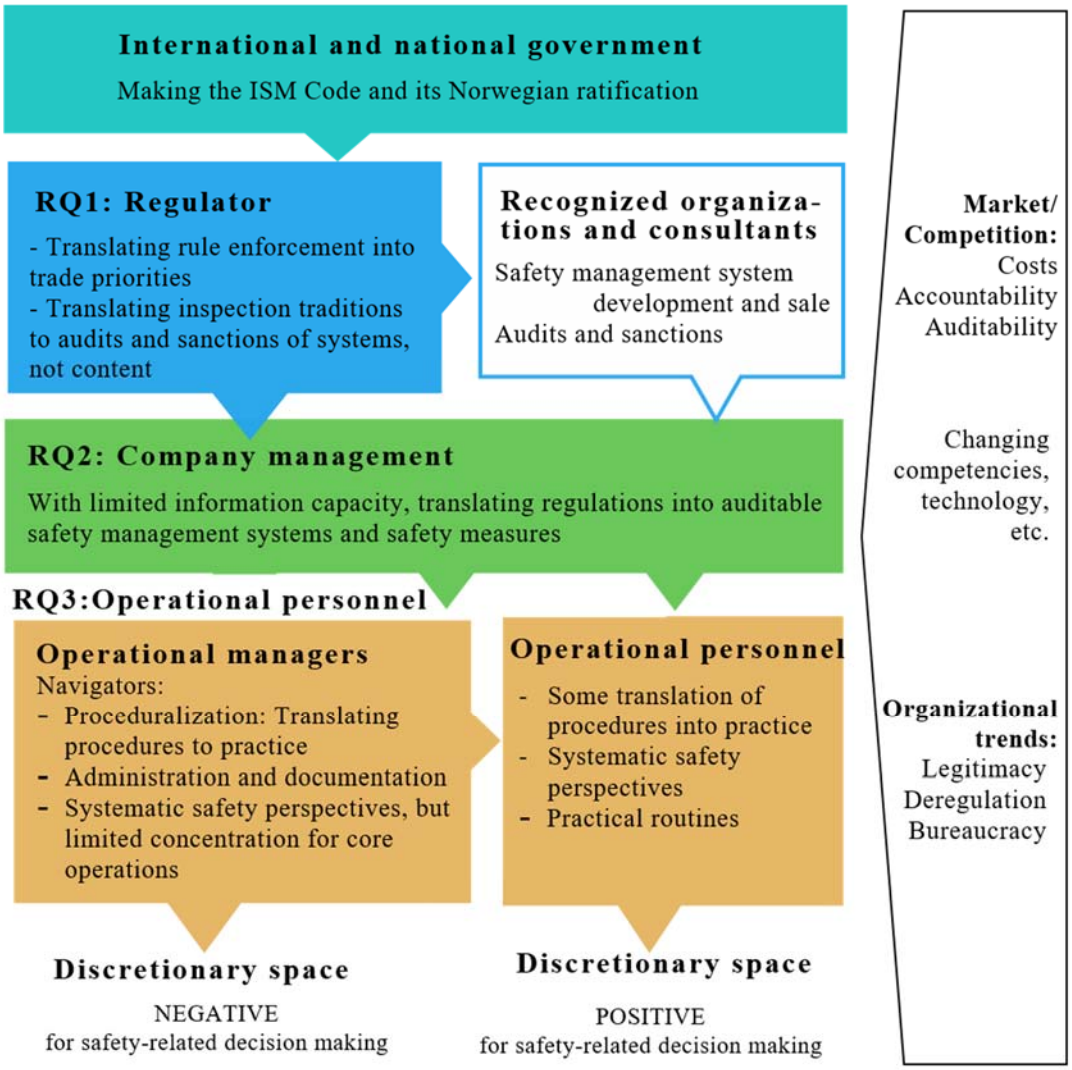

Figure 8: Findings of the ISM Code's influence on regulators, company management, and operational personnel

7.4.2 Intended ISM influence: Conditions for safety-related decision making

In my data, there are indications that the ISM Code can lead to better conditions for safety-related decision making among regulators, management, and operational personnel. The Code and consequent safety management systems have resulted in more knowledge about the underlying causes of accidents, accident prevention, and safety, and therefore more systematic safety awareness, safety measures, and safety investments in Norwegian coastal transportation (as shown in Articles B and D, in line with Lappalainen (2016) and Christophersen (2009)). This indicates that the ISM Code has partly had the influence it was intended to have: encouraging organizational conditions that support safety-related decision making.

Another intention of regulation is to limit actors' discretionary space to make decisions that do not favor safety (Baldwin et al., 2011). Empirically, on all levels, this study displays business criteria as the fiercest competitor of ISM compliance. Some conflicts are even formalized. For example, the Maritime Authority interviewees reported safety as a criterion, but are also obliged to follow criteria of national profit and trade and to prioritize service to ship owner (Article A). In the companies and among seafarers, profit, efficiency, and trade also have a large place. Articles A–D describe situations on all levels where business considerations trump safety, but also report that safety and compliance often are the main decision criterion. It is vital that the ISM Code be translated so that procedures can be followed and that support or discretionary space is provided. When criteria such as compliance are mandated but cannot be applied in operations, the criteria become constraints. The ISM Code ends up being inapplicable and ignored, while other criteria such as business gain influence. Even though this often is the case in Norwegian coastal transport, the ISM Code in some way also can influence safety, just as intended.

In addition, these positive contributions for decision making might have helped reduce personal injuries. In any case, Norwegian coastal accident statistics show fewer personal injuries over the last decade (Figure 4), the same period in which the ISM Code has been in force. Article B discusses whether the positive contributions of the ISM Code—safety awareness, training, planning, and safety routines for planning and operations—might contribute to reducing personnel injuries.

7.4.3 Unintended ISM influence: Bureaucracy squeezing discretionary space

It has been clear for years that the ISM Code and safety management systems has unintended negative side effects for safety-related decision making. This has been amply demonstrated in earlier research, in both maritime and other industries (Anderson, 2003; Bhattacharya, 2009, 2012; Bieder & Bourrier, 2013; Grote & Weichbrodt, 2013; F. Knudsen, 2009; Le Coze & Wiig, 2013; Lindøe, Baram, & Braut, 2013; Rosness, 2013; Österman & Hult, 2016). Articles A–D also discuss side effects such as bureaucratization, proceduralization, and imposing constraints on practical competence, discretionary space, flexibility, and capacities to improvise. My data display many examples of how safety-related decision making requires discretionary space and improvisational abilities for personnel on all levels within their

contexts, as was also reported by Dekker (2012); Hollnagel et al. (2006)), as long as they are supported and facilitated by other levels (J. Rasmussen, 1997; Rosness et al., 2012).

This study offers insights into the decision making leading to this bureaucracy. It is the characteristics of internal control regulation, which is function-based and relies on co-regulation, that constrain the decision making on all levels.

Authority representatives have limited discretionary space and are left to oversee the companies' and vessels' ISM Code compliance with the traditional means of control in the maritime industry (Articles A–B). Recognized organizations and regulators oversee each vessel, with regulations and guidelines for inspection and sanctions, and traditions of deficiencies and financial penalties during every inspection. However, they cannot control or sanction the content of the safety management systems themselves.

Company management's compliance with the ISM Code is balanced with economic survival, legitimacy demands, and compliance with other regulations. Management procures systems from health and safety professionals who are likely unfamiliar with the practical situation in an organization (Articles B–C). This leads safety-related decision making toward standardized safety management systems, at the expense of more flexible practical criteria (Article C).

Many safety management systems include so many procedures that seafarers report being unable to "think for themselves" (Articles B–D). Radically restricted discretionary space makes it difficult for a crew to engage in abductive reasoning and consider how to handle variability and bandwidth management in operations under uncommon conditions, as is vital for a safe organization (Dekker, 2012; Hayes, 2010; Hollnagel, 2011; K. A. Pettersen, 2013; E. Roe & Schulman, 2008). Sometimes, seafarers' only alternative is to ignore the mandated procedures. On the studied vessels, it is common that for navigators as local administrators assigning tasks to subordinates to translate safety management systems by giving practical instructions on what is to be done and within which discretionary space. The navigators deliberately spare their subordinates while they have to worry about documentation, administration, and non-compliance, even while they must attend to their own important duties. Staying up to date in documentation, accountability, and practical skills constrains the navigators' safety-related decision making in ways that could contribute to conditions resulting in ship accidents (Article B).

7.4.4 Unintended ISM influence: Auditability out of control

In safety literature and Articles B–D, there are signs that the influence of the ISM Code could be closer to its intentions if safety management systems were established in line with operational values. It is common to present it as a problem of different competencies and discordant views between management and operational personnel (i.e., Bhattacharya, 2009; Bieder & Bourrier, 2013; Dekker, 2017b; Grote, 2012; Hale & Borys, 2013a; Vandeskog, 2015). However, the extensive safety management systems are rooted in the ISM Code itself, along with other societal trends, that trickle down through all levels and between actors.

The ISM Code disqualifying itself

The ISM Code is a function-based rule set that instructs companies to establish a system that can be inspected both internally and externally through audits. The ISM Code calls for safety management systems that fit a company's specific activities, but they also must be auditable and documented. These two requests are in conflict. Still, it is common for functional rule sets to include conflicting accountability demands.

The main task of regulators, together with recognized organizations, is to ensure that companies comply with the Code, mainly by auditing their safety management systems. This makes companies deeply concerned with audits. The practicality of safety management systems therefore can become a secondary goal, while the systems are primarily meant to be easily auditable, because companies need to demonstrate accountability as a matter of legitimacy (as explained by Hohnen and Hasle (2011)). Within this logic, liability must also be covered by the safety management system. Today, the only common way to control compliance is by auditing standardized tasks, which can severely hamper the usability of the systems for the operational personnel. In the maritime industry, it is common for standardized procedures not to match the local activities (Antonsen et al., 2008; F. Knudsen, 2009; Oltedal & Engen, 2011; Vandeskog, 2015, etc.). So, the translation processes on all levels result in reduced influence for the core parts of the ISM Code, which aims to ensure sea safety.

Simply put, the aim of the ISM Code is overcome by its clauses about auditing and verification. Even though the ISM Code facilitates locally made safety management systems, its emphasis on documentation, verification, and control makes it difficult to handle in a non-bureaucratic way. Company management is "forced" to make safety management systems that do not actually increase safety for the navigators in their role as local administrators and their operations. As described, it is difficult for both regulators and companies—and certainly seafarers—to counteract extensive safety management systems when so many societal trends are drivers for their development and persistence.

Cementing societal trends

The combination of research literature employed in this study reveals that the problem lies within the characteristics of the ISM and the societal trends of which its development and implementation are products (Figure 9). The societal trend of accountability plays a powerful role in how international and national safety management regulations are made. Together with trends toward deregulation and bureaucracy, it paves the way for standardization, documentation, proceduralization, and the demand for internal control systems, which in turn demand audits. Identities and rules change as part of the process in which institutions adapt to their environments (March, 1994, p. 77). The problem of the audit society has been here for twenty years: governments must demonstrate that co-regulation is legitimate because companies are accountable (Baram & Lindøe, 2013), while tasks need to be documented and standardized to become auditable (Hood, 2007, 2011; Power, 1994, 2004).

What Power (1999) calls the "audit society" has created a mix that can lead safety management systems to run out of control. Auditing seems institutionalized now. It is a deep-

rooted culture-based organizational idea, as Czarniawska and Sevón (1996); Røvik (2011) would put it.

The data for this thesis do not offer answers on how to reduce audit demands, but they do demonstrate their consequences within coastal transport and why an *audit implosion* is wanted. Audit implosion refers to audits being abandoned or completely concentrated and reformed. Jensen and Winthereik's (2017) use of audit implosions describes how the idea of audits has travelled, been transformed, and changed from within an audit way of thinking.

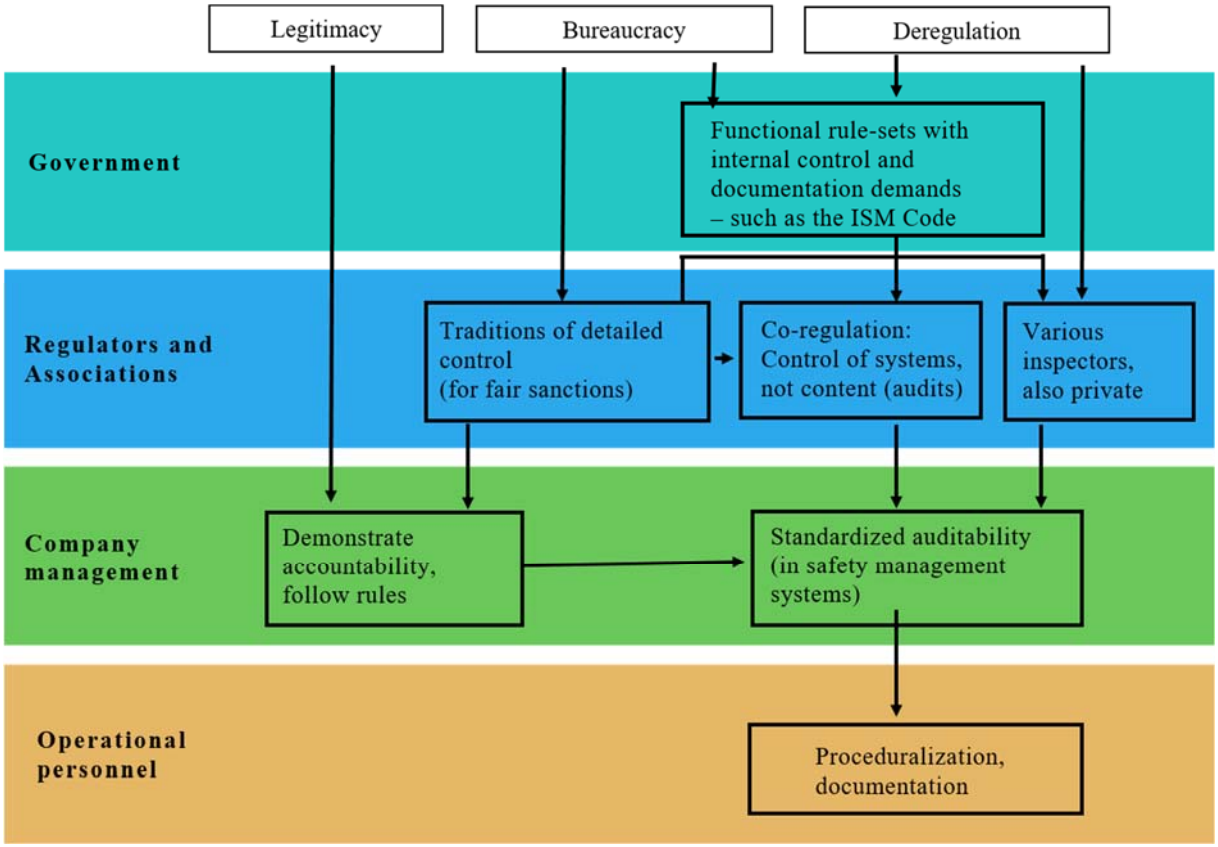

Figure 9: Combined trends causing the ISM Code to constrain decision making unintentionally on the three studied levels; positive (intended) influences are excluded from this figure.

Useless measures and potential research

It has proven difficult over several years to counteract the side effects of internal controls, safety management systems, and risk management (e.g., Dekker (2012, 2017b); Grote (2012); Hale and Borys (2013a); Hollnagel (2011); Power (2004). Safety is trapped in rules (Bieder & Bourrier, 2013). This same chorus of researchers calls for a greater discretionary space for the operational personnel, including participation in creating practical safety management systems. However, a simplification of procedures and a bureaucracy that is not at the service of safety have not led to satisfying results.

Even regulations about participation have had an effect on Norwegian safety management systems. The only Norwegian twist on the content of the ISM Code is a rule requiring seafarers' participation in creating those systems (Norwegian Ship Safety and Security Act § 7: the ship-owning company's duty to implement and maintain a safety

management system, through participation of the crews of each vessel). This has seemingly no value when the ones implementing and controlling such systems are most concerned with the systems being auditable. The major part of the ISM Code is about control and verification. This almost makes it understandable that company managers decide to buy general, easy-to-audit safety management systems. There is no use in letting operational personnel make the rules, if the company still has to add rules to fit into the audit envelope.

Nevertheless, my data indicate that controls are far from perfectly fair and objective, so it seems unnecessary to create or adopt enormous safety management systems in order to audit fairly.

Some movements steadily work against the audit regime, such as *resilient engineering* (Hollnagel et al., 2006) and *safety differently* (Dekker, 2015). Organizational conditions like trust and discretionary space for improvisation are essential for these approaches to work.

Many researchers have pointed to the need to innovate how safety is maintained in maritime and other industries (for example Amalberti, 2013; Bieder & Bourrier, 2013; Dekker, 2015, 2017a; DeSombre, 2006; O. F. Knudsen & Hassler, 2011; M. S. Roe, 2013). The ISM Code has been criticized as excessively compliance-focused (Bhattacharya, 2012; Schröder-Hinrichs et al., 2016). The development of better safety regulations appears to be paralyzed in the existing maritime market (Article A). Since actors with power disagree, there is no development in policymaking, but more rules would not necessarily be a safer alternative (O. F. Knudsen & Hassler, 2011).

There is a need for research into control methods and how auditors can contribute to achieving useful safety management systems. At bottom, control is a governmental responsibility, which has to some degree been outsourced to private companies. The national governments may have some discretionary space to improve safety within the existing frameworks, perhaps through new approaches to control?

One could re-install trust by taking documentation away from operational personnel and work coordinators and leaving in place locally adapted procedures and maintenance routines. In this scenario, there would be no need to change the ISM Code itself, only its influence on how documentation and auditing are carried out. A company with a good safety reputation does not necessarily need to document that fact for people to understand it. We need new ways to understand how a safe organization works.

7.5 The theoretical building blocks

In this thesis, safety research, theories about regulation and accountability, and organizational theory about trends in society and the translation of ideas are used to discuss how safety-related decision making is affected by the ISM Code. This combination has led to the overall contribution of the thesis: a proposal about how safety management systems have been sent in the wrong direction, how the present internal control regulation and audit regime might be the problem, and a possible key to finding a solution. Below, I summarize how previous literature has been useful and how this thesis contributes to our scholarly knowledge.

I elaborate on research related to *safety management systems* to find that when "safety is trapped in rules" on the Norwegian coast, seafarers' decision making is both constrained and helped. General research certainly applies to this context, but the seafarers' stories make it even more evident that oversight and audits play an essential part in the quality of safety management systems and the possibility of participating in change.

Earlier research on safety regulation is also employed; I have shown how it elucidates maritime safety management regulation. The ISM Code influences the levels below, but combined with other environmental conditions, the influence of the ISM Code is not always as intended.

My data are consistent with much of the earlier research about the ISM Code, but also expands it in important ways. One key contribution of this thesis is that the Code's two parts contradict each other. Another valuable distinction is how safety management systems differently affect seafarers with different degrees of administrative tasks.

The decision setting of navigators in their role as local administrators is affected negatively, which could be related to an increase in ship accidents. Further research should investigate any links with personal injuries and ship accidents in this context and injuries and organizational accidents in other industries.

7.6 Concluding remarks on audit implosion

The ISM Code aims to prevent ship accidents and personal injuries by influencing the actors in the industry and to be a counterforce to unwanted practices like hunting profits. In this thesis, I describe how the ISM Code influences the decision making of Norwegian Maritime Authority representatives, ship-owning company management, and seafarers in positive and negative ways.

Two substantial results shed light on frustrations found in earlier safety management research and practice: the ambivalent efficiency of safety management systems, which sometimes come out as good instruments, but are usually poor; and that the intended influence has been so difficult to achieve. Consequently, I propose a diagnosis of why the ISM Code and similar regulations partly fails to achieve its goals and offer a reason for the polarized outcomes.

Regarding the failed goals, this study has shown that the ISM Code is in practice self-contradictory. This is especially because it is built on and combines several societal trends: the Code was created and is enforced and implemented in a way that makes its safety goals vulnerable to being overrun by audit implications. It is common to state that the regulation is not developed in a more practical and usable way because of factors like competition, different stakeholder interest, and prioritizing profit (Christophersen, 2009; Lappalainen, 2017). My data point to this too, but they mainly indicate that the problem really lies in the audit requirements in the ISM Code and the traditions of how to audit and be accountable. Regulators and companies enforce and implement poorly fitting safety management systems because they think they are powerless against forces of control and accountability (Article A–C). I have elucidated how the control regime of ISM and similar regulations is one reason for the last decade's many

failed attempts to develop practical, useful safety management systems. Simple function-based rules like the ISM Code cannot be transformed into simple safety management systems in companies when the systems must be overseen by today's auditing regimes, unless one has a very innovative auditor or simply acts like an anarchist, as urged by Dekker (2017b).

Regarding the polarized effects, the analyses in this study indicate that the audit focus of the ISM Code has different influences for navigators as local administrators and other operational personnel. Earlier research found some opposite results about the ISM Code, such as both negative (Bhattacharya, 2009) and positive (Lappalainen, 2016) consequences for safety work. One reason might be that the Code's negative influences are concentrated on the local administrators who have their own tasks in addition to translating and documenting procedures for operational personnel. Safety management systems mostly benefit the operational personnel, contrary to what they commonly say. This especially applies to crews with local administrators who are familiar with the operational work.

The distinction between the ISM's influence on personnel with different degree of administrative responsibility might be applicable to other industries and workplaces with different safety management regulation. The fact that local administrators have to deal with negative effects is not apparent in literature about safety management systems, even in maritime research about middle managers and captains. Still, the same undesirable outcome might occur to control room operators, operating managers, health leaders, and teachers. This notion could even be one reason why the international research community has been stuck in a discussion about whether the ISM Code and other internal control regulations have positive or negative effects.

Overall, this analysis demonstrates a need for an *audit implosion*. Regulators, companies, and operational personnel would all benefit by safety measures less concerned with auditability and documented accountability. That could enhance the positive influence of safety management systems by establishing routines and creating discretionary space for safety-related decision making. Also other areas of society experience the tension between practical work and revisions, and could benefit by less focus on auditability. One alternative would be to scrap regulation in general, have *no audits*, and invent new ways to oversee safety compliance. A more realistic alternative would be *less and other types of audits* within existing regulations. This thesis and other studies have shown that safety management systems can be practical. Under the ISM Code, there is clearly discretionary space to create and control systems other than what largely exists today. The Code has the potential to help transform how audits are performed and how auditable safety management systems should look. At least in theory, audits can positively influence safety-related decision making.

Safety could be made into an asset, something of competitive value. The maritime industry would not implode if everyone had to increase their safety investments. Rather, it could be translated into something positive for safety-related decision making. The question is how to start this trend.

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Appendix I: The ISM Code

PREAMBLE

1 The purpose of this Code is to provide an international standard for the safe management and operation of ships and for pollution prevention.

2 The Assembly adopted resolution A.443(XI), by which it invited all Governments to take the necessary steps to safeguard the shipmaster in the proper discharge of his responsibilities with regard to maritime safety and the protection of the marine environment.

3 The Assembly also adopted resolution A.680(17), by which it further recognized the need for appropriate organization of management to enable it to respond to the need of those on board ships to achieve and maintain high standards of safety and environmental protection.

4 Recognizing that no two shipping companies or ship-owners are the same, and that ships operate under a wide range of different conditions, the Code is based on general principles and objectives.

5 The Code is expressed in broad terms so that it can have a widespread application. Clearly, different levels of management, whether shore-based or at sea, will require varying levels of knowledge and awareness of the items outlined.

6 The cornerstone of good safety management is commitment from the top. In matters of safety and pollution prevention it is the commitment, competence, attitudes and motivation of individuals at all levels that determines the end result.

PART A – IMPLEMENTATION

1 GENERAL

1.1 Definitions

The following definitions apply to parts A and B of this Code.

1.1.1 *International Safety Management (ISM) Code* means the International Management Code for the Safe Operation of Ships and for Pollution Prevention as adopted by the Assembly, as may be amended by the Organization.

1.1.2 *Company* means the owner of the ship or any other organization or person such as the manager, or the bareboat charterer, who has assumed the responsibility for operation of the ship from the ship-owner and who, on assuming such responsibility, has agreed to take over all duties and responsibility imposed by the Code.

1.1.3 *Administration* means the Government of the State whose flag the ship is entitled to fly.

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.

1.1.5 *Document of Compliance* means a document issued to a Company which complies with the requirements of this Code.

1.1.6 *Safety Management Certificate* means a document issued to a ship which signifies that the Company and its shipboard management operate in accordance with the approved safety management system.

1.1.7 *Objective evidence* means quantitative or qualitative information, records or statements of fact pertaining to safety or to the existence and implementation of a safety management system element, which is based on observation, measurement or test and which can be verified.

1.1.8 *Observation* means a statement of fact made during a safety management audit and substantiated by objective evidence.

1.1.9 *Non-conformity* means an observed situation where objective evidence indicates the non-fulfilment of a specified requirement.

1.1.10 *Major non-conformity* means an identifiable deviation that poses a serious threat to the safety of personnel or the ship or a serious risk to the environment that requires immediate corrective action or the lack of effective and systematic implementation of a requirement of this Code.

1.1.11 *Anniversary date* means the day and month of each year that corresponds to the date of expiry of the relevant document or certificate.

1.1.12 *Convention* means the International Convention for the Safety of Life at Sea, 1974, as amended.

1.2 Objectives

1.2.1 The objectives of the Code are to ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment, in particular to the marine environment and to property.

1.2.2 Safety management objectives of the Company should, *inter alia:*

.1 provide for safe practices in ship operation and a safe working environment;

.2 assess all identified risks to its ships, personnel and the environment and establish appropriate safeguards; and

.3 continuously improve safety management skills of personnel ashore and aboard ships, including preparing for emergencies related both to safety and environmental protection.

1.2.3 The safety management system should ensure:

.1 compliance with mandatory rules and regulations; and

.2 that applicable codes, guidelines and standards recommended by the Organization, Administrations, classification societies and maritime industry organizations are taken into account.

1.3 Application

The requirements of this Code may be applied to all ships.

1.4 Functional requirements for a safety management system

Every Company should develop, implement and maintain a safety management system which includes the following functional requirements:

.1 a safety and environmental-protection policy;

.2 instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant international and flag State regulation;

.3 defined levels of authority and lines of communication between, and amongst, shore and shipboard personnel;

.4 procedures for reporting accidents and non-conformities with the provisions of this Code;

.5 procedures to prepare for and respond to emergency situations; and

.6 procedures for internal audits and management reviews.

2 SAFETY AND ENVIRONMENTAL-PROTECTION POLICY

2.1 The Company should establish a safety and environmental-protection policy which describes how the objectives given in paragraph 1.2 will be achieved.

2.2 The Company should ensure that the policy is implemented and maintained at all levels of the organization, both ship-based and shore-based.

3 COMPANY RESPONSIBILITIES AND AUTHORITY

3.1 If the entity who is responsible for the operation of the ship is other than the owner, the owner must report the full name and details of such entity to the Administration.

3.2 The Company should define and document the responsibility, authority and interrelation of all personnel who manage, perform and verify work relating to and affecting safety and pollution prevention.

3.3 The Company is responsible for ensuring that adequate resources and shore-based support are provided to enable the designated person or persons to carry out their functions.

4 DESIGNATED PERSON(S)

To ensure the safe operation of each ship and to provide a link between the Company and those on board, every Company, as appropriate, should designate a person or persons ashore having direct access to the highest level of management. The responsibility and authority of the designated person or persons should include monitoring the safety and pollution-prevention aspects of the operation of each ship and ensuring that adequate resources and shore-based support are applied, as required.

5 MASTER'S RESPONSIBILITY AND AUTHORITY

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.

6 RESOURCES AND PERSONNEL

6.1 The Company should ensure that the master is:

.1 properly qualified for command;

.2 fully conversant with the Company's safety management system; and

.3 given the necessary support so that the master's duties can be safely performed.

6.2 The Company should ensure that each ship is manned with qualified, certificated and medically fit seafarers in accordance with national and international requirements.

6.3 The Company should establish procedures to ensure that new personnel and personnel transferred to new assignments related to safety and protection of the environment are given proper familiarization with their duties. Instructions which are essential to be provided prior to sailing should be identified, documented and given.

6.4 The Company should ensure that all personnel involved in the Company's safety management system have an adequate understanding of relevant rules, regulations, codes and guidelines.

6.5 The Company should establish and maintain procedures for identifying any training which may be required in support of the safety management system and ensure that such training is provided for all personnel concerned.

6.6 The Company should establish procedures by which the ship's personnel receive relevant information on the safety management system in a working language or languages understood by them.

6.7 The Company should ensure that the ship's personnel are able to communicate effectively in the execution of their duties related to the safety management system.

7 SHIPBOARD OPERATIONS

The Company should establish procedures, plans and instructions, including checklists as appropriate, for key shipboard operations concerning the safety of the personnel, ship and protection of the environment. The various tasks should be defined and assigned to qualified personnel.

8 EMERGENCY PREPAREDNESS

8.1 The Company should identify potential emergency shipboard situations, and establish procedures to respond to them.

8.2 The Company should establish programmes for drills and exercises to prepare for emergency actions.

8.3 The safety management system should provide for measures ensuring that the Company's organization can respond at any time to hazards, accidents and emergency situations involving its ships.

9 REPORTS AND ANALYSIS OF NON-CONFORMITIES, ACCIDENTS AND HAZARDOUS OCCURRENCES

9.1 The safety management system should include procedures ensuring that non-conformities, accidents and hazardous situations are reported to the Company, investigated and analysed with the objective of improving safety and pollution prevention.

9.2 The Company should establish procedures for the implementation of corrective action, including measures intended to prevent recurrence.

10 MAINTENANCE OF THE SHIP AND EQUIPMENT

10.1 The Company should establish procedures to ensure that the ship is maintained in conformity with the provisions of the relevant rules and regulations and with any additional requirements which may be established by the Company.

10.2 In meeting these requirements, the Company should ensure that:

.1 inspections are held at appropriate intervals;

.2 any non-conformity is reported, with its possible cause, if known;

.3 appropriate corrective action is taken; and

.4 records of these activities are maintained.

10.3 The Company should identify equipment and technical systems the sudden operational failure of which may result in hazardous situations. The safety management system should provide for specific measures aimed at promoting the reliability of such equipment or systems. These measures should include the regular testing of stand-by arrangements and equipment or technical systems that are not in continuous use.

10.4 The inspections mentioned in 10.2 as well as the measures referred to in 10.3 should be integrated into the ship's operational maintenance routine.

11 DOCUMENTATION

11.1 The Company should establish and maintain procedures to control all documents and data which are relevant to the safety management system.

11.2 The Company should ensure that:

.1 valid documents are available at all relevant locations;

.2 changes to documents are reviewed and approved by authorized personnel; and

.3 obsolete documents are promptly removed.

11.3 The documents used to describe and implement the safety management system may be referred to as the Safety Management Manual. Documentation should be kept in a form that the Company considers most effective. Each ship should carry on board all documentation relevant to that ship.

12 COMPANY VERIFICATION, REVIEW AND EVALUATION

12.1 The Company should carry out internal safety audits on board and ashore at intervals not exceeding twelve months to verify whether safety and pollution-prevention activities comply with the safety management system. In exceptional circumstances, this interval may be exceeded by not more than three months.

12.2 The Company should periodically evaluate the effectiveness of the safety management system in accordance with procedures established by the Company.

12.3 The audits and possible corrective actions should be carried out in accordance with documented procedures.

12.4 Personnel carrying out audits should be independent of the areas being audited unless this is impracticable due to the size and the nature of the Company.

12.5 The results of the audits and reviews should be brought to the attention of all personnel having responsibility in the area involved.

12.6 The management personnel responsible for the area involved should take timely corrective action on deficiencies found.

PART B – CERTIFICATION AND VERIFICATION

13 CERTIFICATION AND PERIODICAL VERIFICATION

13.1 The ship should be operated by a Company which has been issued with a Document of Compliance or with an Interim Document of Compliance in accordance with paragraph 14.1, relevant to that ship.

13.2 The Document of Compliance should be issued by the Administration, by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government to the Convention to any Company complying with the requirements of this Code for a period specified by the Administration which should not exceed five years. Such a document should be accepted as evidence that the Company is capable of complying with the requirements of this Code.

13.3 The Document of Compliance is only valid for the ship types explicitly indicated in the document. Such indication should be based on the types of ships on which the initial verification was based. Other ship types should only be added after verification of the Company's capability to comply with the requirements of this Code applicable to such ship types. In this context, ship types are those referred to in regulation IX/1 of the Convention.

13.4 The validity of a Document of Compliance should be subject to annual verification by the Administration or by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government within three months before or after the anniversary date.

13.5 The Document of Compliance should be withdrawn by the Administration or, at its request, by the Contracting Government which issued the Document when the annual verification required in paragraph 13.4 is not requested or if there is evidence of major non-conformities with this Code.

13.5.1 All associated Safety Management Certificates and/or Interim Safety Management Certificates should also be withdrawn if the Document of Compliance is withdrawn.

13.6 A copy of the Document of Compliance should be placed on board in order that the master of the ship, if so requested, may produce it for verification by the Administration or by an organization recognized by the Administration or for the purposes of the control referred to in regulation IX/6.2 of the Convention. The copy of the Document is not required to be authenticated or certified.

13.7 The Safety Management Certificate should be issued to a ship for a period which should not exceed five years by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. The Safety Management Certificate should be issued after verifying that the Company and its shipboard management operate in accordance with the approved safety management system. Such a Certificate should be accepted as evidence that the ship is complying with the requirements of this Code.

13.8 The validity of the Safety Management Certificate should be subject to at least one intermediate verification by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. If only one intermediate verification is to be carried out and the period of validity of the Safety Management Certificate is five years, it should take place between the second and third anniversary dates of the Safety Management Certificate.

13.9 In addition to the requirements of paragraph 13.5.1, the Safety Management Certificate should be withdrawn by the Administration or, at the request of the Administration, by the Contracting Government which has issued it when the intermediate verification required in paragraph 13.8 is not requested or if there is evidence of major non-conformity with this Code.

13.10 Notwithstanding the requirements of paragraphs 13.2 and 13.7, when the renewal verification is completed within three months before the expiry date of the existing Document of Compliance or Safety Management Certificate, the new Document of Compliance or the new Safety Management Certificate should be valid from the date of completion of the

renewal verification for a period not exceeding five years from the date of expiry of the existing Document of Compliance or Safety Management Certificate.

13.11 When the renewal verification is completed more than three months before the expiry date of the existing Document of Compliance or Safety Management Certificate, the new Document of Compliance or the new Safety Management Certificate should be valid from the date of completion of the renewal verification for a period not exceeding five years from the date of completion of the renewal verification.

13.12 When the renewal verification is completed after the expiry date of the existing Safety Management Certificate, the new Safety Management Certificate should be valid from the date of completion of the renewal verification to a date not exceeding five years from the date of expiry of the existing Safety Management Certificate.

13.13 If a renewal verification has been completed and a new Safety Management Certificate cannot be issued or placed on board the ship before the expiry date of the existing certificate, the Administration or organization recognized by the Administration may endorse the existing certificate and such a certificate should be accepted as valid for a further period which should not exceed five months from the expiry date.

13.14 If a ship at the time when a Safety Management Certificate expires is not in a port in which it is to be verified, the Administration may extend the period of validity of the Safety Management Certificate, but this extension should be granted only for the purpose of allowing the ship to complete its voyage to the port in which it is to be verified, and then only in cases where it appears proper and reasonable to do so. No Safety Management Certificate should be extended for a period of longer than three months, and the ship to which an extension is granted should not, on its arrival in the port in which it is to be verified, be entitled by virtue of such extension to leave that port without having a new Safety Management Certificate. When the renewal verification is completed, the new Safety Management Certificate should be valid to a date not exceeding five years from the expiry date of the existing Safety Management Certificate before the extension was granted.

14 INTERIM CERTIFICATION

14.1 An Interim Document of Compliance may be issued to facilitate initial implementation of this Code when:

.1 a Company is newly established; or

.2 new ship types are to be added to an existing Document of Compliance,

following verification that the Company has a safety management system that meets the objectives of paragraph 1.2.3 of this Code, provided the Company demonstrates plans to implement a safety management system meeting the full requirements of this Code within the period of validity of the Interim Document of Compliance. Such an Interim Document of Compliance should be issued for a period not exceeding 12 months by the Administration or by an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government. A copy of the Interim Document of Compliance should be placed on board in order that the master of the ship, if so requested, may produce it for verification by the Administration or by an organization recognized by the Administration or for the purposes of the control referred to in regulation IX/6.2 of the Convention. The copy of the Document is not required to be authenticated or certified.

14.2 An Interim Safety Management Certificate may be issued:

.1 to new ships on delivery;

.2 when a Company takes on responsibility for the operation of a ship which is new to the Company; or

.3 when a ship changes flag.

Such an Interim Safety Management Certificate should be issued for a period not exceeding 6 months by the Administration or an organization recognized by the Administration or, at the request of the Administration, by another Contracting Government.

14.3 An Administration or, at the request of the Administration, another Contracting Government may, in special cases, extend the validity of an Interim Safety Management Certificate for a further period which should not exceed 6 months from the date of expiry.

14.4 An Interim Safety Management Certificate may be issued following verification that:

.1 the Document of Compliance, or the Interim Document of Compliance, is relevant to the ship concerned;

.2 the safety management system provided by the Company for the ship concerned includes key elements of this Code and has been assessed during the audit for issuance of the Document of Compliance or demonstrated for issuance of the Interim Document of Compliance;

.3 the Company has planned the internal audit of the ship within three months;

.4 the master and officers are familiar with the safety management system and the planned arrangements for its implementation;

.5 instructions, which have been identified as being essential, are provided prior to sailing; and

.6 relevant information on the safety management system has been given in a working language or languages understood by the ship’s personnel.

15 VERIFICATION

15.1 All verifications required by the provisions of this Code should be carried out in accordance with procedures acceptable to the Administration, taking into account the guidelines developed by the Organization.

16 FORMS OF CERTIFICATES

16.1 The Document of Compliance, the Safety Management Certificate, the Interim Document of Compliance and the Interim Safety Management Certificate should be drawn up in a form corresponding to the models given in the appendix to this Code. If the language used is neither English nor French, the text should include a translation into one of these languages.

16.2 In addition to the requirements of paragraph 13.3, the ship types indicated on the Document of Compliance and the Interim Document of Compliance may be endorsed to reflect any limitations in the operations of the ships described in the safety management system.

Appendix II: Four research articles

Article A:
Størkersen, K. V. (2015). Survival versus safety at sea. Regulators' portrayal of paralysis in safety regulation development. Safety science, 75, 90-99.

Article B:
Størkersen, K. V., Kongsvik, T. Ø., & Antonsen, S. (2017). One size fits all? Safety management regulation of ship accidents and personal injuries. Journal of Risk Research, 20 (9), 1154-1172.

Article C:
Almklov, P. G., Rosness, R., & Størkersen, K. (2014). When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge? Safety science, 67, 25-36.

Article D:
Størkersen, K. V. (2012). Fish first: Sharp end decision-making at Norwegian fish farms. Safety Science, 50 (10), 2028-2034.

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Survival versus safety at sea. Regulators' portrayal of paralysis in safety regulation development

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ABSTRACT

Safety regulation can decrease the frequent accidents in sea transportation, but aspects of the existing regulations are found to contribute *negatively* to safety. Earlier studies suggest other framework conditions to influence maritime safety more than regulation, without reviewing the relation between the maritime context and regulation. Therefore, this paper explores maritime regulators' safety-related decisions. The data consist of interviews with regulators and facts about other actors (i.e., politicians, shipping companies, interests groups, and the media) in the maritime transport arena. The findings, which are based on safety, decision-making, and arena theories, are not described by earlier research.

Primarily, I find that a paralysis constrains safety regulation. Despite wanting a safe industry, transport competition leads the maritime actors to disagree about the priority of safety or profit, which paralyzes safety regulation development and constrains the regulators and their discretionary space (where they enforce the right safety regulations for the right sectors). Many of the decision criteria with which regulators must comply are forced upon them by others, so that regulators see them as constraints. Safety regulation is further weakened when market forces influence both regulation-making and enforcement. The findings demonstrate that industrial or political actors do not prioritize safety in practice; however, safety priority could lift maritime transport above the choice between safety and survival.

1. The regulator's lot

The safest form of transport is by sea, but the number of serious maritime incidents has risen over the last decade (IMO, 2012). Globally, there are several large-scale accidents every year, such as the disasters of the ferry *Sewol* and freighter *Grand Fortune I* in 2014. In 2013, at least 69 large vessels were declared total losses, with over 600 casualties (Maritime Bulletin, 2014) out of approximately 1,300,000 seafarers worldwide (IMO, 2012). This paper explores safety regulation from the viewpoint of the regulators.

Regulation can be an important defense against organizational accidents if one has resourceful regulators with discretionary space (Reason, 1997; Rasmussen, 1997; Walters et al., 2011). Regulation motivates maritime organizations to take safety precautions (Kongsvik et al., submitted for publication; Knapp and Van de Velden, 2011), but the trend toward auditability and accountability as safety measures can marginalize useful safety practices and improvisation abilities (Almklov et al., 2014; Dekker, 2014; Størkersen and Johansen, 2014; Bieder and Bourrier, 2013). In spite of such secondary effects, research shows this type of regulation continues due to *lack of* resources: maritime deaths in poor sectors are not given public attention, let alone funding for regulatory development (Lindøe et al., 2011). Societies tend to be skeptical about expanding regulation in general, so regulators are often lagging compared to industry innovation (Walters et al., 2011; Johnson, 2014). Rather, multiple transnational actors in global industries come in, alongside the national regulators, with heavy means to influence standards and safety measures, thus adding complexity and uncertainty, and corrupting the regulators' work (Bratspies, 2009). At the same time, legislators and other governmental institutions with different objectives give the regulators responsibilities without authority (over legislation, insurance, market forces, etc.), and then tend to blame the regulator if a case gets negative attention (Baram and Lindøe, 2014). Reason (1997) labels it "the regulator's unhappy lot": regulators are to take care of societal interests, but with limited discretionary space, funding, or understanding. No wonder other framework conditions seem to influence maritime safety more than regulation (Kongsvik et al., submitted for publication; Knudsen and Hassler, 2011; Walters and Bailey, 2013). Earlier research does not explain further how the maritime context influences the regulators.

In this paper, I explore maritime regulations by asking Norwegian maritime regulators *what affects the regulators' decisions when*

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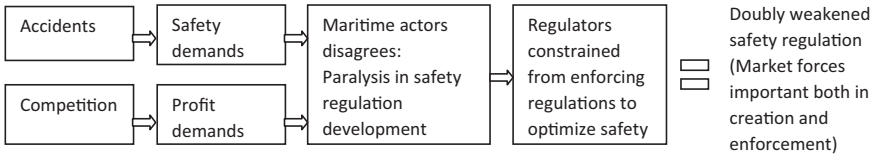

Fig. 1. Competing problems and priorities leads to weakened safety regulation in maritime transport.

facilitating for safe maritime transportation? I find that transport competition makes many maritime actors prioritize profit over safety regulation, which paralyzes safety regulation development and constrains the maritime safety regulators (see Fig. 1).

In the analysis, I use literature about safety, decision-making, and arena theory, which is explained in Section 2. As in arena analysis (Georgakopoulos and Thomson, 2008), my data materials consist of document analysis and interviews, though the interviews are only with the regulators (see method description in Section 3). The regulators' descriptions of their own decision-making are voiced in Section 4, categorized by the arena actors to which they relate the subjects, together with some information about the actors. In Section 5, the regulators' decision-making is analyzed, followed by a discussion of the situation of the maritime arena, to find out what affects the regulators' decision-making and to present the contents of Fig. 1.

2. Literature about regulatory decision-making in an arena

Decision-making and risk literature often mention that regulators are dependent on politicians and other actors around them. Yet studies seldom provide insights about the regulators' perspectives on their regulation and the context. To analyze what affects the regulators' decisions, I use an arena model (Renn, 1992) as a starting point to employ further decision-making theory (literature overview by Rosness, 2009).

As *safety* is a background subject here, this term must be clarified first (according to Rasmussen, 1997, 184): "Safety depends on the control of work processes so as to avoid accidental side effects causing harm to people, environment, or investment". A business can be safe to both people and economic profit. However, sometimes all negative side effects are unavoidable, and a value conflict arises over which of the positive effects one should prioritize (for instance, personal health or environment). Whether an operation is safe or not depends to a large degree on decisions made, before and during the operations, by groups of personnel at multiple societal levels and settings.

2.1. The arena approach

The arena approach can help explain group responses to risk issues and interpret institutional and political actions (Renn, 1992), such as the regulators' decision-making. An arena is a sphere or domain with certain participants, policies, interactions, and decision-making processes (Georgakopoulos and Thomson, 2008). In an arena, an actor has *discretionary space* – room for decisions and actions within a system (Dekker, 2012). The arena model (Fig. 2) illustrates patterns of such actors and the activities between them.

Arena theory is based on assumptions that the actors can influence and convince their decision-makers (by arguing or through public pressure) if they have sufficient resources available (Renn, 1992). Formal power is often not enough to get successfully one's preferred actions acted out in an arena. Authority must be accompanied with other valuable resources, such as social influence or financial capacity. Many arenas are so full of political constraints that decisions are not necessarily made in accordance with the values of any of the participants. If none of the actors can dominate the process, there can be a case of *political paralysis* and issues can remain unresolved (Renn, 1992). Political paralysis occurs when several actors fail to cooperate and decide on collective measures because of different values and goals.

2.2. Decision-making on the regulatory level(s)

Decision-making is seen as an individual or collective activity, over shorter or longer time, more or less intentional, constrained and shaped by context and individual qualities (Rosness, 2009). A decision is close every time an actor can choose to act out other alternatives. It is difficult to separate the decision from the decision-making process, and it is important to take into account the social context of the work (March, 1994; Rasmussen, 1997; Rosness, 2009).

Rosness (2009) characterizes decision settings based on proximity to the hazard and level of authority.[1] Currently, regulatory institutions are juggling between *political arenas*, *business management*, and *administrative and technical support functions*. Table 1 shows the dominant constraints and decision criteria in these decision settings (Rosness, 2009).

In the *business management* setting, managers rely on information from subordinates, and might not be able to weigh a full set of pros and cons. They are concerned with economic outcome and can be motivated to continue operations in conflict with safety (Rasmussen, 1997; Reason, 1997). Often, business decision-makers easily understand the process and value of the product (which can lead to bankruptcy if not handled right), while it is harder to recognize the processes and value of personnel or organizational safety (which can lead to catastrophe if not treated right) (Reason, 1997). This implies that they can value short-term financial and survival criteria rather than welfare, safety, and environmental criteria (Rasmussen, 1997). Employees are often pushed to work fast even if, theoretically, they should strive instead for quality. Hollnagel (2009) calls this the efficiency/thoroughness trade-off (ETTO) principle.

The *administrative and technical support functions* refer to personnel with limited formal authority, such as regulatory staff. Osmundsen et al. (2012) have found that the Norwegian Food Safety Authority personnel are obliged to make decisions that balance between societal interests and industrial interests, but that rigid regulations can limit their authority, constrain the decision-making, and sometimes result in irrational decisions.

In the decision setting of *political arenas* there are likely to be conflicting interests, as pointed out in arena theory. For instance, one often hears that "safety has a high priority, but so has employment and trade balance" (Rasmussen, 1997, 184). Interest groups are important here, due to the power in lobbies and the ability of interest groups to raise the voice of the public (Lindøe et al., 2011). Profit priority is often the case amongst maritime industry actors (Walters and Bailey, 2013).

[1] Rosness (2009) describes five decision settings: operations, business management, administrative and technical functions, political arenas, and crisis handling. For an example of research using his model on operational decision-making in Norwegian fish-farming, see Størkersen (2012).

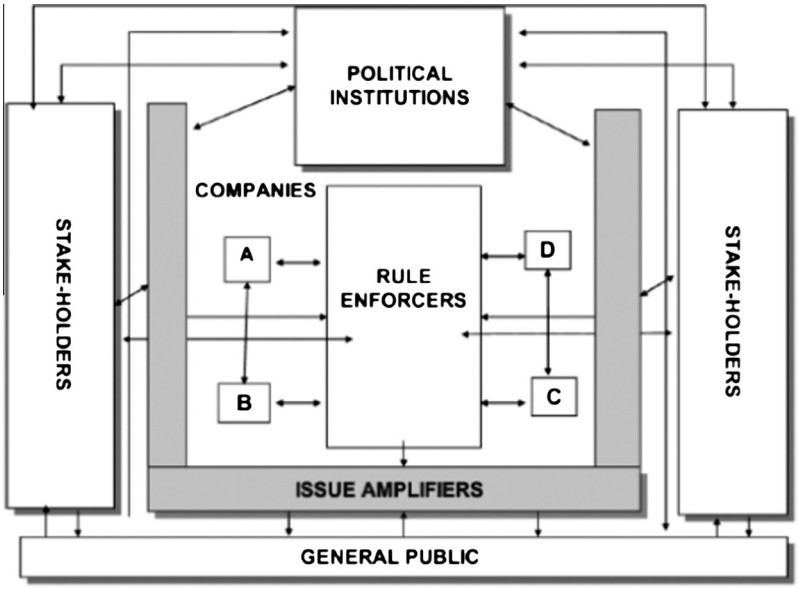

Fig. 2. The actors in an arena (Renn, 1992, as printed in Georgakopoulos and Thomson, 2008, 1120).

Table 1
Characteristics of the three relevant decision settings (Rosness, 2009, 809).

Decision setting	Dominant constraints	Dominant decision criteria
Business management	Information-processing capacity	Optimize profit (or other key performance indicators) Avoid trouble
	Dependence on information filtered by subordinates	Ensure commitment or compliance Efficient decision-making
Administrative and technical support functions	Limited hands-on knowledge No authority to enforce decisions	Comply with rules and standards Consistency Optimize a single attribute
Political arenas	Conflicts of interest Changing constellations of power	Robust consensus Secure status of decision-maker

3. Material and methods

This study based on interviews with persons from the maritime industry in different Norwegian research projects during the last decade (i.e., for the arena of aquaculture, see Fenstad et al., 2009; for offshore platform service, see Fenstad et al., 2010; for cargo shipping, see Størkersen et al., 2011; for high-speed passenger vessels, see Kongsvik and Johansen, 2013). Sources for the quotations given in this paper's results are specifically group and single interviews from 2011 and 2012, in the research project *Regulative rationalities and safety culture development*.[2] The 17 interviewed persons work at the Norwegian Maritime Authority and the Norwegian Coastal Administration (see Table 2). These representatives were selected because they manage especially relevant departments or have knowledge specific to the department's work and contact with the industry or other actors. Selections were also made so that, altogether, knowledge from most parts of the maritime regulatory organizations was covered.

The interviews took place at the authorities' offices at different locations, and were executed by one to three of the project's researchers. All interviews were semi-structured research interviews of 1–2 h duration, and discussed the regulators' role to maintain safe maritime operations, how that role is performed in practice, how regulators cooperate with each other and others, etc., were discussed. The interviews were recorded, transcribed, and translated into English. The representatives from the two regulators had mainly the same views in most cases (which were quite surprising in themselves).

In the analyzing process, I applied the arena model (see Fig. 1 and the explanation in Section 2). The model was not used to select interviews, but it was implemented after data gathering as an analysis tool to categorize the data, to find patterns and to get an overview of how the regulators view the participants, interactions, challenges, and possibilities for decision-making in the arena (as suggested by Georgakopoulos and Thomson, 2008). Consequently, the empirical results in Section 4 in this paper are organized with respect to the actors of the arena.

Before the results of each actor type are presented in Section 4, each actor is introduced in a table. These facts are used to give an impression of the actor and of the arena altogether. Even though the different actors are presented briefly in the tables, all qualitative results are subjective perspectives of the regulators only. Consequently, this study mostly reflects the views of the regulators, and does not take into account the possible perspectives of other actors.

As this study only reflects the views of selected representatives for Norwegian maritime regulators, the findings cannot be general-

[2] The project aims to find out how culture influences safety on various organizational and societal decision-making levels – from the workers on deck, through the shipowners, to the authorities. We started with studying how the authorities view their own role when it comes to safety in the industry, and continued with asking employees in industry organizations about their roles and their views of the other levels.

Table 2
Data used to find the results in Section 4.

	Maritime authority	Coastal administration	Total
Interviews	9	3	12
Interviewed	13 key persons in departments working with strategic safety, laws and regulations, international affairs, passenger ships, cargo ships, inspection, and working and living environment	4 key persons in departments working with coastal administration, ships and safety	17

ized to other nations and arenas. Still, the results might shed light on some general aspects of the international maritime arena or general regulators' discretionary space in relation to other actors.

4. Empirical results about the authorities' views on safety regulation

In the interviews, the regulators from the Norwegian Maritime Authority and the Norwegian Coastal Administration characterize their decision-making. Fig. 3 provides an overview of the maritime transport arena based on information from the interviews.

This section is divided into subsections of the arena-actor types, depending by whom the regulators perceive their decisions are influenced. Each subsection starts with information about the current actor before continuing with the regulators' descriptions from the interviews. Altogether, this will give a picture of the Norwegian maritime arena, with perspectives from the regulators.

4.1. National rule enforcers: regulations and internal discussions

As described, two national regulators facilitate for maritime safety by controlling the vessels or maintaining the infrastructure along the Norwegian coast: The Maritime Authority and the Coastal Administration. See more information about them in Table 3.

Representatives from both the Maritime Authority and the Coastal Administration say they have some discretionary space to act on their own to prevent accidents in maritime transport, even though they work with limited resources and need to discuss interpretations and priorities among their peers.

When asked, the regulators state that they are satisfied with the policies they take care of (even though many add that the rules are comprehensive). Most of the regulators started their interview with a basal premise from the Norwegian Law on Ship Safety: Safety is the responsibility of the shipowners, and regulations require them to fulfill a minimum safety standard. All the represented regulators feel that they still play an important role in the creation of safety along the coast. They give and deny permits, make regulations (for instance speed limitations for certain areas), improve the emergency preparedness in an area or sub-branch, interact with the local authorities, try to make practical and manageable instructions, handle complaints, and so on.

> *We actually have an easy job. We're put here to exercise regulatory requirements – equality for the law. Whether we like the complainers or not, we maintain equality for the law. We have to focus on the facts, no matter what.*

However, the regulators also underline some negative aspects with the policy-making and the formation of the regulations. Much of the Norwegian maritime regulation originates from international legislation. For instance is the International Safety Management-code integrated in the Norwegian Law of Ship Safety. National formulations are sought from cooperation between unions, employer organizations, and regulators (although several of the interviewed regulators point out the lack of funding to carry out such thorough processes). It is said that many of the rules are marked by fights between the parties; "*who gets through or whose*

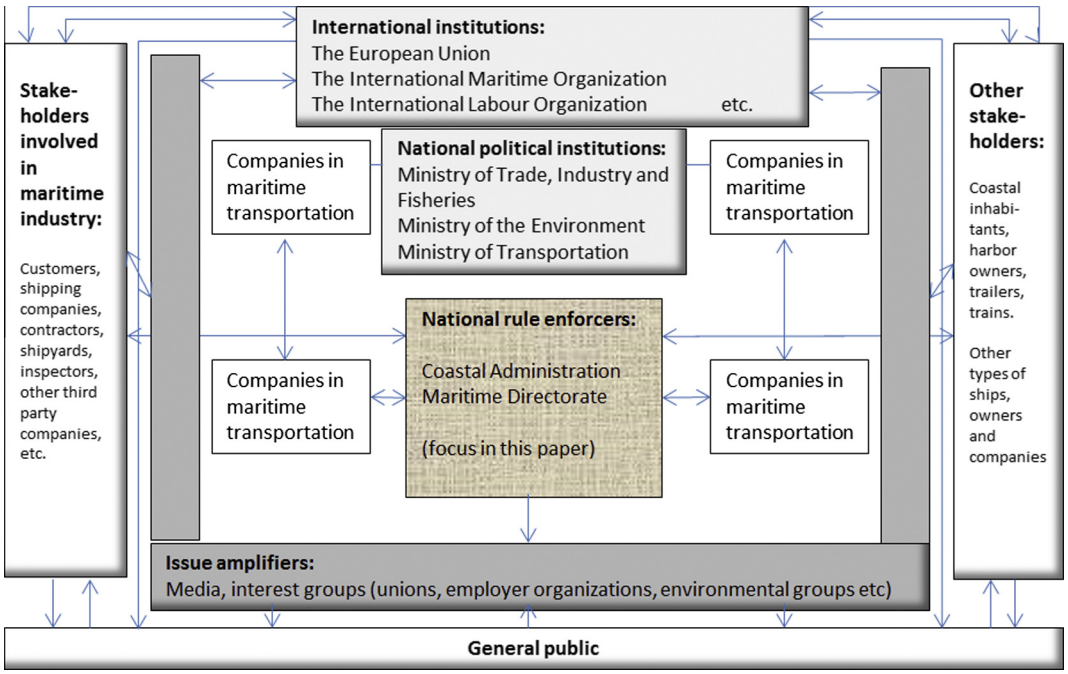

Fig. 3. Actors important for the Norwegian maritime transport arena.

Table 3
The Norwegian maritime regulators.

	Norwegian Coastal Administration Source: Coastal Administration (2014)	Norwegian Maritime Authority Source: Maritime Authority (2014)
Employees	Approximately 1000	307
Tasks	Responsible for infrastructure: fairways and fishing ports, port facility security, pilot and navigation services, vessel traffic services, national preparedness against acute pollution, transport planning. Exercising maritime legislation	Supervision of the industry: Controls Norwegian vessels according to national regulations, and other vessels in Norwegian ports according to international regulations. Assure that Norwegian shipowners hold high safety and environmental standards and employ seafarers with good qualifications and working and living conditions. Manages the Norwegian ship registers
Goal	"To make our coast and waters the safest and purest in the world"	"To be a visible actor for sea safety in a clean environment"
Owner (s)	*At the time of the interviews:* The Ministry of Fisheries and Coastal Affairs (in charge of coastal industry and pollution preparedness) *From 2014:* Norwegian Ministry of Transport and Communications (responsible for framework conditions for postal, telecommunications, and transport activities; roads, coastal environment and port and sea transport policy)	The Ministry of Trade, Industry and Fisheries (responsible for designating industrial and seafood policy with an eye to the future) and The Norwegian Ministry of Climate and Environment (responsible for carrying out environmental policies)

compromises are chosen. When you form regulations, you are soon entering the politics". The regulators' political owners (see Fig. 3 and Section 4.4) are also in position to change the focus of finances and priorities. Even if regulations favor safety, the regulators can feel pressured to enforce the owner's goals of continuing trade, industry, and culture – at the expense of safety.

"We want to get most safety for least resources", repeat the representatives. They talk about how some safety measures are worth the investment (life vest campaigns and so on), while others are important but too expensive (for instance, improved requirements for safety ladders, mandatory pilots, and increased safety crew).

Subjects that *are* internally debated are competence, knowledge, and information gathering. The Maritime Authority is especially engaged in how much data they need to issue certificates, when they do not have the time to seek out every piece of information.

4.2. International institutions

The transport industry is essentially international. For instance, 90% of the Norwegian fleet is active abroad, and foreign ships are frequent in Norwegian waters (Norwegian Shipowners' Association, 2014). Norwegian regulations include a complex set of ratified international rules, which the Maritime Authority enforces over the Norwegian shipowners and vessels (Pettersen and Bull, 2010) (see Table 4).

The Norwegian regulators are connected tightly to international institutions, whose regulation-making processes are thorough and time-consuming. An example from the IMO that was emphasized in the interviews is a term about life-raft hooks, which the regulators tell was completed ten years after initiation of the process because "*consensus was not made until more accidents had occurred*."

The Maritime Authority representatives in particular underline that the international standards are bound to be frustratingly low. As long as lobbyists can argue that a country or an industry cannot afford higher standards, the international standards will not contain high safety demands (such as those made by the new Maritime Labour Convention, in the Norwegian regulators' opinions). Even though many of the interviewed regulators are dissatisfied with the safety standards on many vessels, their experience is that they neither can make Norwegian rules too strict compared to other nations' rules. Because maritime transport is so internationally oriented, a shipowner can perceive it as easier to flag out of Norway and into flags of convenience, than to comply with firm regulations. Norwegian officials say that they fear a situation where no vessels are registered in Norway and, consequently, are out of reach of the Norwegian regulators. They also fear that no foreign vessels or companies will bring their business to Norway. According to the regulators, strict Norwegian special-safety demands will scare business and national states, and in turn lead to global protection. Norwegian politicians do not want to encourage this.

Vessels registered in other countries must be treated carefully as long as they meet the international standards, even if they do not comply with all Norwegian regulations. This is said to be

Table 4
International government in the Norwegian maritime arena.

EU	The European Union (EU) is an economic and political partnership between 28 European countries. Every action taken by the EU is founded on treaties that are negotiated, agreed, and ratified by all the EU member states (EU, 2013) Countries not in the EU but part of the European Economic Area (EEA) must adopt parts of EU Law to enjoy free trade with the EU. These states (Iceland, Liechtenstein and Norway) contribute to the formation of new, relevant legislation at an early stage. However, they have no representation in or formal opportunity to influence further decision-making in the EU, although they are obliged to ratify it (Wikipedia, 2014; EFTA, 2014)
ILO	Policies of the International Labour Organization (ILO) are set by the annual International Labour Conference. Each member state has two government delegates: an employer delegate and a worker delegate. Every delegate has the right to express himself or herself and to vote freely when establishing conventions. Member states can choose to ratify the conventions. ILO's Maritime Labour Convention (MLC) sets labor rights for seafarers, and thereby fair competition for shipowners. The MLC was adopted by the Conference in 2006 and entered into force worldwide in 2013. (ILO, 2014a,b)
IMO	The International Maritime Organization (IMO) is the United Nations' specialized agency with responsibility for maritime safety and security, and prevention of pollution. The conventions in the IMO are established through consensus by all member states. When every government has consented to a formulated convention (such as the International Safety Management Code, ISM), they are obliged to enforce it. It often takes years to make a convention. (IMO, 2012)
National and port-state enforcement	The Norwegian Maritime Authority enforces Norwegian regulations with ratified conventions over Norwegian registered vessels, and enforces directly the general international conventions over other vessels in Norwegian ports (Pettersen and Bull, 2010)

Table 5
The Norwegian maritime transport industry in numbers.

Maritime transport versus air, rail, and roads	Maritime transport competes with transport on road, on rail, and in air. In Norway, many coastal communities depend on sea transport due to the long coastline. In 2013, sea transport had 52 million passengers (less than rail and roads) and carried 88 million tons of cargo (less than roads). (Statistics Norway, 2014e)
Industry value	The Norwegian fleet is the world's fifth largest in value (Norwegian Shipowners' Association, 2014). In 2012, the production value in water transport was 20.9 billion US dollars (while the total production value in the general Norwegian transport industry was 52.6 billion USD) (Statistics Norway, 2014d)
Employees and company types	App. 152,120 employees are in Norwegian water transport, with 21,061 enterprises (Statistics Norway, 2014d) consisting mostly of 1–10 employees and 1–10 vessels. Transport vessels include cargo and passenger ships: oil tankers, well boats, vehicle carriers, ferries, express boats, general cargo vessels, and more. This is a complex group, with very different framework conditions. Some companies and sectors have low economic margins, such as Norwegian coastal cargo (Størkersen et al., 2011). Lindøe et al. (2011, 94) have described national and international bulk transport as complex, with "low cost" organizations using short-term contracts and "third world" work forces. In contrast to this, petroleum supply and large international cargo companies have financial muscle
Vessels, numbers	2767 transport vessels were registered in Norway in 2013, for both coastal and international activity[a] (Statistics Norway, 2014a,b)
Flags	A substantial number of foreign registered ships and seafarers sail along the Norwegian coast. Some vessels originate in the countries they flag. Others have Norwegian owners, but are flagged in a country with different regulations (for instance, regarding tax, demands, and prohibitions) (Kristiansen, 2005)
Risk of death	In 2013, 281 Norwegian seafarers were injured and 5 killed (Statistics Norway, 2014c). The risk varies across the different transport branches. Seafarers' risk of death is 10 to 20 times greater than for onshore workers (Norwegian National Insurance Service, 2006). Globally, there were 600 causalities in the same year (Maritime Bulletin, 2014) among app. 1,300,000 seafarers (IMO, 2012)
Vessels lost	In 2013, 18 Norwegian registered vessels were totally lost, and 246 partially lost (Statistics Norway, 2014c). Globally in 2013, 69 large vessels were declared total losses (Maritime Bulletin, 2014)

[a] The transport fleet is also called the merchant fleet, but the formal definition of merchant fleet only includes vessels that do not carry passengers and are 100 gross tons or more (Statistics Norway, 2014a). In this study, passenger vessels and smaller freighters are included.

because of the principle of national sovereignty; the national regulators are supposed to control their ships, and other nations have to trust them to do that.

> *If a boat with a Bahamas flag lies in the harbor of [a Norwegian city], it's the Bahamas who lie in this harbor. And that's pretty important, I tell you.*

4.3. Companies in the industry

See Table 5 for facts about the Norwegian maritime industry. As previously stated, the Norwegian shipowners are responsible for the safety on their ships along the coast (Lovdata, 2007). The regulators want the companies to upgrade the safety standards from the regulation's minimum on the companies' own initiatives. In addition, the regulators initiate safety measures and run campaigns in branches and on vessels with a large number of accidents and limited industry safety initiative. The regulators indicate that their efforts to promote safety in maritime transport are indeed affected by the companies. All interviewed regulators want to level with the industry, but they also see that some maritime transport companies only make safety investments when sanctions are possible.

> *To invest in safety equipment for [50,000 US dollars] can be a hard nut. But as soon as there are requirements, things happen.*

Representatives from both regulatory bodies highlight how it would have been safer with a newer fleet with better safety equipment, "*but*", they always add, "*there are all sorts of considerations to make*": Norwegian shipping is threatened by international shipping, while all shipping is threatened by other transport types. The competition is lowering prices. The regulators are very aware of the pressured economic state in parts of the maritime transport arena. The Maritime Authority representatives, in particular, are clear about their focus on branches with small safety budgets. They emphasize that regulations cannot push the business out of the country or over to trucks by demanding expensive safety measures. Some, therefore, reluctantly understand the ministries' priorities.

> *You always have to balance on that border. We'll never get a chance to think of only profession. We can argue for it, then hand it over to the ministry. And in some cases the ministry will get back to us and say "this isn't working".*

They do not want to shut down the business for a shipowner, a local community, or a maritime transport branch (for example, sand transport) as long as the actors can be said to comply with regulations. Therefore, the Norwegian maritime regulations cannot be too demanding, as compared to the rest of the maritime world or the transportation industry. Some of the persons interviewed believe that the priorities of the regulatory bodies would have been different if they had other owners. This will be discussed further in the next section.

4.4. National political institutions

Much of the political implications on regulation have been apparent already in the sections about rule enforcers, international regulation, and the companies, so this section is mainly about the differences in priorities between politicians and regulators (see the national political institutions' goals in Table 6).

In all interviews, the regulators emphasize the border area between *professional judgment* and *politics* (as seen in the last quote). The regulators understand their *profession* to be safety (or safety-related decision-making), while *politics* are perceived as values handed down from the politicians. This tension between safety and the priorities of the ministries is stressed strongly by the regulators. They worry that politicians can make decisions that can be problematic for safety. At the same time, the regulators are aware of the importance of satisfactory business conditions for the industry, so as to be able to have an industry to regulate. They still regret that politicians have a veto, are influenced by the public, media, lobbies, the next election, etc. – and can delete the work of hundreds of regulators in one media interview. Some of the regulators reveal that they rather wish they were owned by a hypothetical Sea Safety Ministry:

> *There's so much politics in the picture here. We're owned by ministries [. . .]. So it's not always that industry and trade and safety are very well united. [. . .] There's no Sea Safety Ministry, for instance. I'm not saying I take easy on [the actual priorities of the owners]. But I say that the combination isn't always as easy. It can be a challenge sometimes.*

Table 6
Goals of Norwegian political institutions relevant for the maritime arena.

General goal	All Norwegian governments of the last decade have aimed at getting more transport from road to sea (Norwegian Cabinet, 2005, 2009, 2013)
Goals and values of ministries	The Ministry of Trade, Industry and Fisheries (which owns the Maritime Authority) is responsible for the government's industrial, shipping, and seafood policy, so as to maximize value creation in the Norwegian economy. The Ministry promotes trade and entrepreneurial spirit. (Ministry of Trade, Industry and Fisheries, 2014) The Ministry of Transport and Communications (which now owns the Coastal Administration) is responsible for transport, telecommunication, and postal policies, including sustaining coastal environment and culture (Ministry of Transport and Communications, 2014). The Ministry of Fisheries and Coastal Affairs (owner of the Coastal Administration at the time of the interviews) also were to maximize the fishery and aquaculture trade and industries

4.5. The general public and issue amplifiers

When the regulators mention the public they often refer to what they hear through the media, but sometimes the public also knocks on their door, as complainers, interest groups, or others with opinions (presented in Table 7). The regulators do not talk much about the nongovernment organizations and lobbying, but they highlight that there is a tight connection between those cases the media draws attention to, and the fields in which the interest groups are engaged.

The experience of the interviewed regulators is that the media are, to some extent, in a position to affect how the resources are being prioritized. Some say that "*we jump when the media tell us to*." Several examples given in the interviews state this.

> *We had a case about dangerous cargo on ferries, with lots of trouble and lots of publicity in the papers, where we in a way were forced into a process. And where the ministry pushed us to find a solution. Yes, we absolutely have those cases.*

Another example say that because of earlier media attention, there now is a focus in Norway on safety for ferries instead of vessels with more serious accidents.

The media's power, especially over the political institutions, is a dilemma for the regulatory bodies, but many of the representatives underline that, usually, the general operation of the organizations does not get disturbed by media attention.

5. Discussion of the situation in the maritime arena

The empirical data from the regulator interviews and the information tables can be analyzed to find what affects Norwegian maritime regulators' decision-making. First, in this section the regulators' decision criteria and constraints are discussed according to Rosness (2009) (see Table 1). This leads to a discussion of how the maritime-arena context affects regulation.

5.1. The regulators' decisions and discretionary space

All decisions made by the Maritime Authority and the Coastal Administration are intended to provide safety along the Norwegian coast. This coincides with the top value of both organizations: safe sailing (Maritime Authority, 2014; Coastal Administration, 2014). Compliance and consistency are also important criteria, common to bureaucratic rationality, to preserve justice. Regulators are to be fair, and treat every client equally.

So, safety, compliance, and consistency are the fundamental decision criteria for the Norwegian maritime regulators. But to be practical (and avoid trouble), they also need to make decisions based on optimization of profit, efficiency, and consensus, with its various constraints.

Within their discretionary space, the regulators strive to reach robust consensus. The regulators must suggest and enforce regulations upon which the ministries, the public, the industry, and interest groups can agree. Now and then, the decision is not the regulators' to make; for example, when politicians have decided on an action after a media outbreak. Sometimes the regulators disagree with the priorities of politicians. In order to make sense when communicating with the industry, regulators must still translate the conflicting priorities into one integrated meaning. The regulators master translation and balance within their limited discretionary space. Yet they find it difficult to act in many maritime branches because the industry associations have considerable power and their own agenda (as also found by Lindøe et al. (2011)). Regulators toil to show the maritime industry that it is necessary to strike a balance between production and protection, to neither become bankrupt nor create a catastrophe, and that it can be economical to think in long terms and prioritize welfare, safety, and environment (as stressed by Reason (1997) and Rasmussen (1997)). However, the conditions rarely give the regulators the opportunity to set such an agenda, because of their limited authority and discretionary space. Osmundsen et al. (2012) have also noted that regulators are expected to do the difficult task of balancing goals, while their framework conditions are too rigid to give sufficient authority or flexibility. With limited resources, the regulators cannot develop adequately and might not be able to increase safety (as described by Walters et al. (2011)).

As the regulatory bodies are part of a society with short-term economic and efficiency criteria (Rasmussen, 1997; Hollnagel, 2009), they also must operate with a business rationale. The political ministries have more goals than *safe sailing*. They are concerned with trade and economic growth. It is common that societies put production before protection (Reason, 1997). Nevertheless, when the Norwegian government established the regulatory bodies with the purpose of preserving sea safety, the intention seem to have been to give the regulators discretionary space to promote safety. In practice, the regulators still must be sensitive to media and the industry's needs. The regulators talk about the difference between their *profession* (prioritizing safety/protection) and *politics* (prioritizing industry/production). Professionally, they would like to prioritize safety, but the political owners – including the public and industry – value trade and less spending. The regulators therefore aim to get "most safety per dollar" (as they say) to optimize profit for the society. Their budgets give minimal resources of time and people (also described by Walters et al. (2011)). The regulators try to get just enough information to be able to harmonize the most important actors' decision-criteria within time budgets, and to avoid blame.[3] This can be seen as an efficiency/thoroughness trade-off, which most professionals experience (Hollnagel, 2009). The regulators have so many considerations to make prior to their decisions that they cannot realize projects they want.

Minimal discretionary space can lead to inertia, and literature describes regulators' lack of action and competence (Roe, 2013; Johnson, 2014). However, the regulators in this study emphasize that they do as much they can to prevent accidents. Some decisions cannot meet criteria of both safety and business, or compliance and consensus, but the regulators fight to prioritize after their profes-

[3] Hood (2010) writes extensively about the negative and positive consequences of actors' blame avoidance.

Table 7
Example of public representations and issue amplifiers in the maritime arena.

The Norwegian Shipowners' Association	represents app. 160 shipowners and 1800 vessels in tanker and bulk transport; short sea and offshore sector. Goal: "A broad agenda for impact and influence" – to protect members' interests in industrial and employment issues, and play an active role in industry concerns
The Association of Cargo Freighters	represents Norwegian shipowners with a total of app. 300 cargo vessels. Goal: To raise the industry's economic and social conditions and ensure its interests in relations with government, charterers, etc.
The Norwegian Seafarers' Union	represents app. 100,000 seafarers working on Norwegian and foreign vessels all over the world. Goal: Secure safe wage and working conditions for all groups of seafarers, both domestic and abroad
The Norwegian Association of Maritime Officers	represents app. 8000 maritime leaders, such as captains and mates, in all types of ships, in Norway and abroad. One of the main goals is to use influence to ensure framework conditions
The Norwegian Association of Engineers	represent app. 6000 members at sea and on shore, and works for the members' working conditions, such as wages, safety, and competence

Issue amplifiers in the maritime arena can also be different types of media, environmental organizations, classification companies, insurance companies, and other groups and non-governmental organizations – national and international.

sional criteria. They point out that even though they prefer to do more or different actions, they have the discretionary space to enforce regulation securely.

To abstract the findings: this analysis shows regulatory actors constrained in their decision-making (insufficient resources or authority), and thereby have limited discretionary space to make decisions according to their own criteria. In spite of the narrow discretionary space and multiple constrains, they make the most out of the situation and take measures within their boundaries.

Theory-wise, most of the decision-making literature's constraints and criteria gathered by Rosness (2009) are recognizable in the regulator descriptions. However, this study exposes limitations in the theory, because some of the mentioned criteria are in practice constraints for the regulators: profit, consensus, and status of the decision-maker (where the decision is the politicians' and not the regulators') are often contrary to the main criteria of safety, compliance, and consistency. Trying to meet all criteria can also constrain the decision-making. When the literature needs so much elaboration, it indicates that there is not enough research on decision-making from the regulators' point of view.

The regulators emphasize several reasons for their constraints and limited discretionary space. For instance, national regulations are coupled with international agreements, and therefore suboptimal tools; political owners can determine or overrule the regulators' priorities; the internationality and fear of "flagging out" makes the industry powerful, as opposed to the regulators. The first reasons are common for regulators in general, and the last is found also by Lindøe et al. (2011). Together, they show that the Norwegian maritime regulators' decision-making is constrained by other actors' criteria, so the arena around the regulators needs examination.

5.2. Safety decisions in the maritime arena

How the maritime arena affects Norwegian regulatory decisions is discussed in this section.

Relevant literature states that regulators are dependent on the international context, the public's interest, politicians' priorities, and the industry's financial capacity (Lindøe et al., 2011; Rosness, 2009; Bratspies, 2009; Walters et al., 2011; Walters and Bailey, 2013; Reason, 1997; etc.). The regulators' drawing of the maritime arena takes this further, and shows that competition is a key attribute that results in profit being optimized instead of safety, causing paralysis in maritime safety regulation development (and thus further constraining the regulators).

The regulators depict the maritime arena as a place where most actors have many constraints and conflicting goals, so the arena cannot land upon joint inventive safety decisions. Lindøe et al. (2011) have shown that even multiple seafarers' loss of life is not enough to make actors prioritize safety. Some studies show that ratified international conventions can result in better maritime safety (i.e. Knapp and Franses, 2009; Knapp and Van de Velden, 2011), while others dispute that regulations can reduce accidents when many states ratify, but still does not implement conventions (Knudsen and Hassler, 2011). About regulation, both the regulator interviews and previous research (see for example, Almklov et al. (2014), Dekker (2014), Bieder and Bourrier (2013), Walters and Bailey (2013), and Antonsen et al. (2012)) suggest that achieved safety conventions from the last few years have not *developed* the regulation; instead, they have lowered standards and used worn-out regulatory ideas of standardization, audibility, and accountability. The non-existing safety-regulation development indicates a political paralysis, to use Renn's (1992) term. Paralysis of safety regulation development is connected with competition: competition between maritime transport and other transport sectors, and especially competition between the countries and companies in the maritime transport industry.

Maritime transport is often low priced in order to compete with *other transport sectors*. The harsh competition leads many transporters to live continuously near bankruptcy, while others have a solid financial situation. The companies, shipowners, and general maritime transport industry see no other solution, if their business is to survive, than to shorten the margins so as to be cheaper than trucks and trains. This is often argued by the companies (to the regulators) as to why they cannot spend more on safety solutions than is regulatory required.

Competition *between countries and companies in the maritime industry* leads to at least three aspects that favors profit and hinder safety regulation development.

First, some countries or markets cannot afford to maintain high safety standards. This is one reason why the consensus-based international structures struggle to decide upon safety regulation. All countries represented in the IMO must agree before a convention is reached. Consequently, possible treaties have to fit to all types of economies and waters, and therefore can take up to a decade to accomplish. When the general argument is that everything must be able to be applied and complied with in every country, none of the arena actors are able to persuade the others to invest in expensive safety regulation. Therefore, from the Norwegian regulators' point of view, standards are set too low to be particularly useful. Walters and Bailey (2013) show that globalisation and the political and industrial economic-priority result in unsafe conditions for the seafarers.

Second, politicians usually want as much activity and trade as possible in their country. Norway is ratifying the conventions from the EU, IMO, ILO, etc., with some national additions, but stricter safety demands seldom are added. This is because scrupulous regulation is associated with fewer international competitive abilities for Norwegian industry. Decision-makers do not

want to inflict large investments on companies when many shipowners have limited investment capacity. Political decisions (and thereby regulators) are constrained by the fear of ruining businesses, industries, and communities. In addition, high safety demands are believed to stop foreign ships from coming to Norwegian waters and ports, or provoke other countries to answer with protectionism, leading Norwegian shipping or other industries abroad to suffer (as also DeSombre (2006) points out more generally). The latter argument is also used by those wanting to keep businesses from moving to other countries. This takes us to the third and last argument of why international transport competition in the maritime arena leads to paralysis in safety regulation development.

Third is the scare of "out-flagging." Some states offer convenience flags, which enforce mild regulation on ships and shipowners, and allow them to operate almost all over the world with limited control and safety demands (Kristiansen, 2005). Politicians fear that implementing special national rules can encourage their fleet to leave Norwegian ship registers and thereby trade balance. DeSombre (2006) say this makes states race toward the regulatory bottom (but governmental and issue amplifying actors can pressure the regulation-makers in the opposite direction, to the regulatory middle). Increased accidents the last years are strongly linked with new or expanding flags (Robers et al., 2013). This study's regulators explain that all arena actors consider safety as important, but there is no use in safety regulation if one does not have an industry to regulate because it went bankrupt or flagged out. This logic makes safety regulation difficult.

All these examples reveal that many arena actors – in the perspective of the regulators – think mostly of competition, and make decisions to optimize profit, not safety. The accidents and competition challenges in the maritime arena make the actors prioritize diversely (see also Fig. 1). International institutions facilitate for safety, but politicians prioritize trade and worry about out-flagging, protectionism, and budgets, and delegate safety to regulators. Industry and interest groups do not want accidents either, but set economic survival and profit first (as generally clarified by Reason (1997)). Some regulations have been agreed upon during the last few years (such as the Maritime Labour Convention in 2006; effective from 2013), but according to the interviewed regulators, the conventions are half-hearted and too elementary. Actual development requires priority. None of the maritime actors have enough resources to convince each other to invest deeply in safety regulation. In the wording of Renn (1992), there is *political paralysis* in maritime-safety regulation development. It is also possible to call it a *regulation paralysis*, because the regulation development is paralyzed. If using that term, it is important to emphasize that the regulators' regulation enforcement is constrained, not paralyzed.

When regulation development is paralyzed, it constrains the regulators' safety facilitation. The regulations that exist are enforced, but the regulators do not see their discretionary space as sufficient to maintain sea safety. The interviewed regulators experience double standards when the politicians and ministries employ regulators to work for safety, while the ministries in practice want the regulators to prioritize what is in the media spotlight. Mearns (2014) has also pointed out the double standards of politicians and society, when the public expects to consume cheap products, but after accidents is stunned by poor safety measures. In my study, the regulators wonder if it had been easier if their owners also had safety as the first priority. Nevertheless, they do not believe that one actor could be so powerful and resourceful that it could persuade the industry into prioritizing safety, and thus end the paralysis in the maritime arena. If the public were sufficiently interested in safe maritime transport, it would be another case.

6. Conclusion and comments

To find out what influences maritime safety regulation, I have analyzed interviews with Norwegian maritime regulators, together with information about other maritime actors. The empirical data go further than, but are not contradictory to, earlier research.

This study highlights a serious international issue: Even though the maritime accident rate calls for better safety regulation, transport competition makes many maritime actors prioritize profit rather than safety, which paralyzes safety regulation development and constrains the maritime safety regulators. Because the market forces get precedence over safety, paralyzed innovative formation and constrained enforcement of regulation weaken the safety regulation double. According to the regulators, when the maritime arena rarely agrees upon safety standards, these standards are set too low and are non-innovative. Thus, development does not happen. (This can be shortened to *regulation paralysis*.) The regulators are not paralyzed, though; but they must do their job within a small discretionary space and without suitable tools – and sometimes the politicians override their decisions. The regulation becomes even weaker if the regulators formally are the only actors to prioritize safety in the maritime arena, yet their decisions are contaminated. With more discretionary space, the regulators could prioritize which transport sectors need most safety attention, and which regulations could prevent the most accidents.

Different opinions about which problem to solve first – survival or safety – stand in the way for transport safety. Implicit in the interviews lies a skepticism against the widely accepted idea that low safety demands are the only way to keep the maritime transport industry alive. To ignore the need for safety regulation in order to keep all companies' heads above water will probably not lead to more safety in either the short or the long run (as Walters and Bailey (2013) strongly underline). For the regulators, it is common to consider whether or not the companies are able to overcome potential safety regulations financially. If the companies continuously are close to bankruptcy, there will never be more safety or thriving maritime transport industries. Rather, reducing safety demands can create a negative spiral, where poorer and poorer organizations give poorer services and become less safe, and thus scare the costumers away. That could paralyze the entire industry, not just safety regulation development. When some coastal cargo companies are functioning on a bare minimum, they stay at a minimum, with no developmental possibilities or power (Størkersen et al., 2011). If the government really wants the industry to survive, they must fully prioritize it. When the amount of accidents is not decreasing, it is important to give enough resources to safety protection, and to search for measures that actually work (as also stated by Bieder and Bourrier, 2013).

A persistent question in the aftermath of this study is how to end the regulation development paralysis in practice. The regulators' present solution is balancing and translation, but this does not eliminate the problem. There is a need for contemporary research on the pros and cons of the different maritime regulation strategies, or of transport regulation in general. It can be appropriate to research the ministries' discretionary space, and to discover how actors could be convinced to invest in safety. Today, the maritime transport actors seem to be penny wise and pound foolish, when they save on safety standards to save the industry.

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One size fits all? Safety management regulation of ship accidents and personal injuries

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One size fits all? Safety management regulation of ship accidents and personal injuries

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Safety management regulation is an important supplement to market forces to establish a sufficient safety level in high-risk industries. The accident statistics in Norwegian maritime passenger transportation display a paradox: personal injuries have decreased while ship accidents have increased in the period during which safety management has been regulated (the International Safety Management Code was effectuated in the late 1990s). We interview regulators, shipping company management, and crewmembers about their practices and opinions regarding safety management regulation and use these data to explore how this *regulation influences safety management practices to prevent different types of accidents*. This study underlines earlier research showing that regulation serves to 'raise the bar' by heightening the industry levels of safety investments and organizational safety awareness. In addition, our results suggest that safety management regulation in maritime transportation is mostly effective for preventing personal injuries in cases in which the personal have sufficient time and resources available, and the procedures are consistent with seafarers' professional values. For ship accidents, such as groundings, other causal factors come into play. We find that the negative consequences of regulation (proceduralization) in particular influence the performance of safety-critical tasks, such as navigation. This may explain why personal injuries have decreased while ship accident frequencies have continued to increase in spite of the regulations aimed at improving safety.

Keywords: regulation; maritime industry; ISM code; seafarers

1. Introduction

Regulation is society's means to make companies run according to its values. Regulation is therefore a counterforce against competitive forces that can lead, for example, to worker exploitation and unsafe working conditions (Bhattacharya 2012). Since the 1990s, the introduction of self-regulation and functional requirements has been a key strategy to improve safety. In maritime transportation, one of the world's oldest, high-risk industries, this is formalized in the International Safety Management code.[1] It was developed by the International Maritime Organization and requires shipowners to make their own safety management systems (SMSs). Hence, maritime international safety regulation is tightly connected to SMSs.

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At the same time, there have been two divergent developments in accident statistics in Norwegian waters. While the frequency of personal injuries has decreased, ship accidents have *increased* (Maritime Authority 2014, 2015). This paradox may have a number of possible explanations, such as increased automation, reduced manning, changes in reporting, and so on, but the differences in the statistical trends are so extensive that these factors could hardly explain all of the variation. The present study links this paradox to the way in which the ISM code is implemented among Norwegian shipowners.

The problem to be addressed is the following: *How does safety management regulation influence safety management practices and the efforts to prevent personal injuries and ship accidents?* The problem is explored through a qualitative study in the maritime industry, involving passenger ship management and crewmembers as well as national regulators. By following the ISM code, all the way from the general regulatory level to the sharp end of ship operations, we are able to see how the operationalization of the code in many ways changes the overall logic and intentions of the regulations.

Our interview data in Norwegian maritime passenger transport elucidate the positive and negative consequences of the ISM code found in earlier research and suggest that this regulation is valuable for reducing individual accidents. In relation to ship accidents, there are some powerful framework conditions in the industry that reduce the significance of the ISM code.

In the next section, we present some background information about Norwegian passenger transportation, safety, and regulation. Our methodological approach is explained in Section 3, while the results and analysis of the data are presented in Section 4. The findings are discussed in Section 5, followed by the conclusions of the study.

2. Norwegian maritime passenger transportation

Norway has a long history as a maritime nation. The lengthy coastline makes the sea important in terms of both employment and transportation. Operating in Norwegian maritime passenger transportation are 402 companies with a turnover of approximately 1.442 billion euros and 9817 employees on ferries, cruise ships, charter boats, high-speed crafts, and so on (Statistics Norway 2015).

In the period from 2000 to 2014, 938 ship accidents and 2704 personal injuries on passenger ships in Norwegian waters were reported (Maritime Authority 2015). The statistics include personal injuries that caused 72 .h or more of sick leave (Maritime Authority 2014). They are often related to clamps, stabs, chemicals, falls, or burning during loading, discharging, cooking, provisioning, mooring, and maintenance. Only 0.55% of the injuries (15 of 2704) happened on the bridge during navigation. Of the 2704 injuries, 281 were related to ship accidents. Ship accidents involve damage to or loss of vessels, most frequently related to groundings, collisions with quays and bridges, and fires. Ship accident investigations mostly establish that the navigation was disrupted before the accident, due to technical error or the navigator being inattentive or asleep.

The statistics show divergent trends since 2000. Personal injuries have decreased considerably at the same time as ship accidents have increased (Maritime Authority 2015, 2014). The last decade's accidents involving Norwegian-registered passenger vessels in Norwegian waters are depicted in Figure 1. Both the total accident

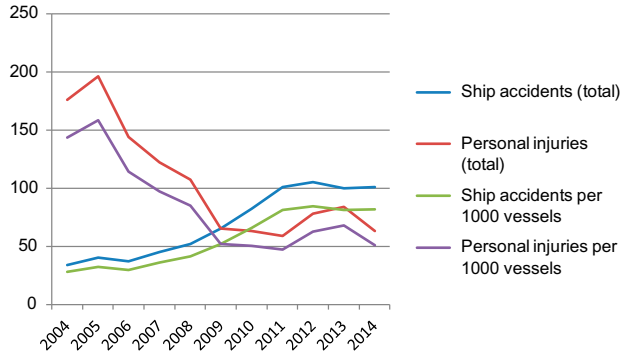

Figure 1. Ship accidents and personal injuries in total and per 1000 passenger vessels on Norwegian passenger vessels in Norwegian waters 2004–2014 (Maritime Authority 2015)

numbers and the frequencies (accidents per 1000 registered vessels in Norway) demonstrate the same contradictory pattern.

2.1. Competitive tendering

Passenger vessels operating Norwegian coastal routes are privately owned but contracted by the Norwegian counties. The counties apply *competitive tendering* to acquire passenger transport services. Norwegian competition law demands that the cheapest vendor is to be chosen if other aspects are equal (Lovdata 2006). Usually, the counties add technical criteria for the vessels and otherwise expect the shipowners to satisfy the regulations (Gullestad 2013). This implies a strong motivation for cost reductions and efficiency improvements to stay in business: the cheapest tenderer is not likely to include extra safety measures. It is more likely to fulfill the minimum requirements in the law. In addition, most counties fine shipowners each time their vessels do not adhere to their schedule. This shows that competitive tendering and competition legislation constitute a powerful framework condition that pushes toward the minimum safety level (Gullestad 2013).

3. Safety regulation

The term 'regulation' usually refers to a form of control exerted by a public agency over an activity that is seen as important to a community (Selznick 1985). A core mission for regulators is to influence the behavior of actors in 'their' industry (Baldwin, Cave, and Lodge 2011). Related to risk, regulation is about the protection of employees, customers, and society (Grote and Weichbrodt 2013). Recently several authors have pointed to the role of environmental factors in influencing the safety management practices of organizations (e.g. Rosness et al. 2012). Regulations can be regarded as one such environmental factor by constituting important framework conditions for companies' safety management.

Most stately regulation follows a trend of deregulation: instead of creating and controlling detailed prescriptive rules about certain subjects, the regulator establishes goals or functions with which the companies must comply (Walters et al. 2011; Lindøe, Baram, and Renn 2013). Since the companies are responsible and the

regulator controls them, this is called co-regulation (Baram and Lindøe 2013, 22). For co-regulation to be legitimate, there must be a close relationship between the regulator and the companies in the regulated industry as the regulator has to trust the companies to implement systems that lead to the described goals and the companies must trust that the regulator is competent to evaluate them.

3.1. Maritime safety regulation

Seafaring has been an international activity for centuries. The increasingly global nature of the maritime industry limits the influence that single states can exert, making international agreements important to regulate maritime transportation.[2] The international regulation of maritime safety started after the Titanic sinking in 1912, with the *International Convention for the Safety of Life at Sea* (SOLAS). It was traditionally about technical standards, such as ship construction and lifesaving appliances for the vessels (IMO 2015).

However, deregulation trends from the 1960s resulted in changes that forced safety management regulation forward (see Bhattacharya 2012 for a thorough overview). Deregulation made the shipowners opt for cheaper and easier regulatory regimes, leading to global competition and weaker rights for the seafarers. A growing number of maritime accidents called for safety management regulations. The catastrophic capsizing of the *Herald of Free Enterprise* in 1987 and the *Estonia* in 1994, of which managerial errors were identified as important causal factors, accelerated the IMO's work with a code to regulate workplace safety and pollution.

'ISM code' is short for the *International Management Code for the Safe Operation of Ships and for Pollution Prevention*, which was established by the IMO in 1993 and made mandatory from 1998. It is designed to 'ensure safety at sea, prevention of human injury or loss of life, and avoidance of damage to the environment (…)' (ISM code, Section 1.2.1). According to the ISM code, a SMS should include, for instance, (1) a safety and environmental protection policy, (2) procedures to ensure the safe operation of ships, and (3) defined lines of communication between shore and shipboard personnel (IMO 2014). The philosophy underpinning the code is total quality management, highlighting continuous improvement through management commitment and personnel empowerment (Lappalainen 2008). Deming's circle ('plan–do–check–act') can be traced in the way in which the code is formulated. This is also evident in secondary laws in Norway, regulating working life in general (e.g. in the concept of 'internal control for HSE') (Saksvik, Torvatn, and Nytrø 2003). A leaflet from the International Shipping Federation (ISF no date) stressed that 'the underlying purpose of the ISM Code is to move shipping away from a culture of "unthinking" compliance with external rules, towards a culture of "thinking", self-regulation of safety'.

The Norwegian ratification of the ISM code on passenger vessels was effectuated in 1995 (Lovdata 2014). Now the code is included in the *Norwegian Ship Safety Act* (Lovdata 2007), which consists of functional requirements and states that companies are responsible for safety on their ships.

3.2. Earlier research on regulation and safety

Within the safety literature, scholars have considered the relationship between regulation, SMSs, and safety to be a key part of the foundation of safety science

(e.g. Rasmussen 1997; Hale and Swuste 1998; Hopkins and Hale 2002). Rasmussen is one of few authors to combine a micro-perspective on safe operation with a more macro-oriented perspective in which regulation is taken into the equation. This is illustrated in his famous model of the socio-technical system involved in risk management (Figure 2).

This is not to be interpreted as a command-and-control model. On the contrary, the actors on each level of the chain have considerable degrees of freedom in their follow-up of other actors, so this is as much a model of self-organization as it is a governance chain (Le Coze and Wiig 2013). This means that regulatory intervention and other measures that involve different levels can be largely unpredictable. The relevance of Rasmussen's work to our study lies in this unpredictability and the way in which regulatory interventions in general are translated into various safety measures as they pass through different levels of the socio-technical model with different environmental influences. We will follow the ISM code down the chain to shed light on its effects, both intended and unintended, on practices and different types of accidents in Norwegian maritime passenger transportation.

Studies show that the ISM code's main objective has been achieved: safety management has improved. In an evaluation of the research literature on the effects of the ISM code, Lappalainen, Kuronen, and Tapaninen (2014, 24) find that the maritime activities 'are more environmentally friendly and more safety-oriented than in

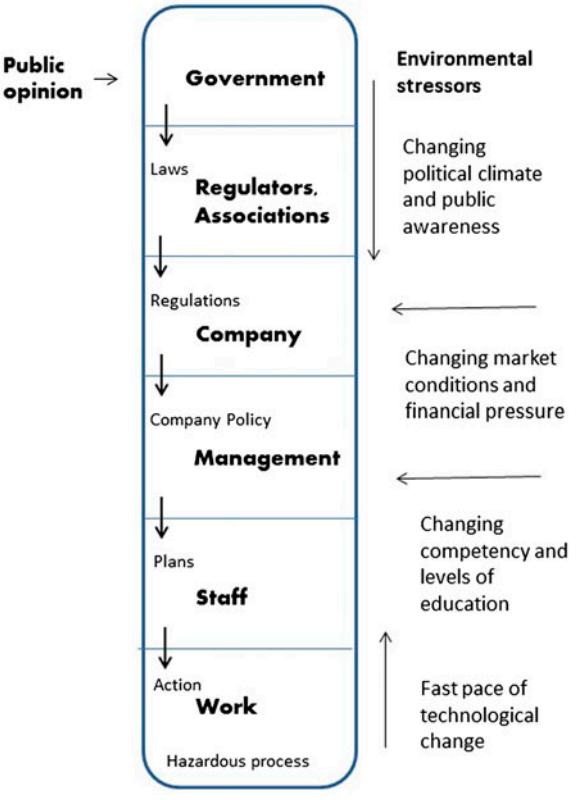

Figure 2. Risk management in socio-technical systems (from Rasmussen 1997).

the 1990s'. The ISM code has heightened seafarers' safety awareness, as they have internalized the principles of safety management over recent years. It should not be forgotten that the companies' responsibility for safety has enhanced their safety investments and communication.

However, contrary to the IMO's ambition to improve maritime safety by formalizing safety management, research also points to several unintended negative consequences. Many are connected to the trend of self-regulation, which results in an enlarged administrative burden on the companies. This burden goes under names such as 'the audit society' (Power 1999), proceduralization (Bieder and Bourrier 2013), or bureaucratization (Dekker 2014; Lappalainen, Kuronen, and Tapaninen 2014; Vandeskog 2015). Heavy administration is mainly a problem because the companies have limited personnel resources and other tasks that are also important for safety (see e.g. Walters et al. 2011; Almklov, Rosness, and Størkersen 2014). This also implies too many or too complicated procedures that hamper compliance: some procedures might conflict with operations or other procedures or might not be known by the operative personnel (see Reason 2013, 1990; Størkersen and Johansen 2014, etc.). As Vandeskog (2015, 105) puts it: 'It is difficult to have faith in a "toolbox" so full that you do not know what tools it contains and cannot find the tool you need when you need it.' Almklov, Rosness, and Størkersen (2014) suggest that these drawbacks may not be due to the ISM code per se, as it could be implemented in a simple and practical manner. Instead, the rules are complicated because of the framework conditions, such as liability law, general SMSs not being adapted to the organization, and so on [also found by Anderson (2003)]. A result of this may be decoupling of the management and operative levels of organizations, with a formal management system as the only proxy. On the other hand, procedures can be reformed through employee participation, which could also improve the employment conditions and the understanding between seafarers and management (Anderson 2003; Bhattacharya 2012; Walters and Bailey 2013).

The professional culture might also work against compliance of the SMSs. Research suggests a weak link between the formal SMSs and the seafarers' informal ideals of work (Bye and Lamvik 2007; Antonsen 2009; Knudsen 2009; Bhattacharya 2012; Kongsvik, Antonsen, and Størkersen 2014; Lappalainen, Kuronen, and Tapaninen 2014; Vandeskog 2015). The ideals of *good seamanship* entail 'a blend of professional knowledge, professional pride, and experienced-based common sense' (Knudsen 2009, 295). Thus, the introduction of formal systems might not be directly compatible with existing cultural features among crewmembers and can marginalize practical, system-specific knowledge (Almklov, Rosness, and Størkersen 2014).

Even though the ISM code was implemented as a counterforce to a global competitive market, cost efficiency is still important for the survival of every shipping company. Therefore, profit and market conditions are used as decision criteria more than safety by shipowners, politicians, and regulators (DeSombre 2008; Bhattacharya 2012; Gullestad 2013; Walters and Bailey 2013; Johnson 2014; Størkersen 2015). Rasmussen (1997, 184) hints at the same mechanisms: 'At the top, society seeks to control safety through the legal system: safety has a high priority, but so has employment and trade.' To cope, shipping companies are found only to implement safety measures required by regulation, 'maintaining the minimum safety level, ensuring that the ISM audits were passed …' (Lappalainen, Kuronen, and Tapaninen 2014, 28).

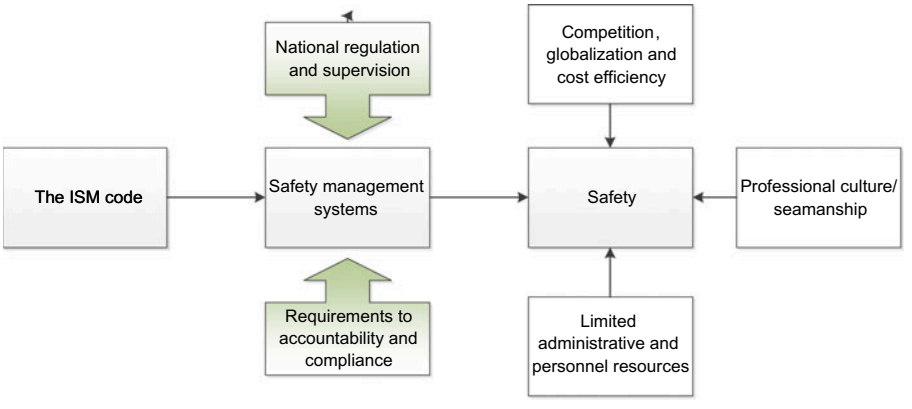

Figure 3. Forces that affect the regulation before the regulation can affect safety management.

Figure 3 illustrates the intention to use the ISM code and SMSs to improve safety and other forces that influence safety, such as global competition, limited resources, and professional culture.

However, neither the ISM code rationality nor earlier research highlights the kind of accidents that the regulation prevents (or does not prevent). When the ISM code has both advantages and disadvantages, and the personal and ship accident statistics point in opposite directions, it is not clear how the SMSs work and whether they work more for some accident types than others. This is the issue discussed in this paper.

4. Method

The empirical foundation for this study is qualitative interviews with 47 representatives from the Norwegian Maritime Authority, the Norwegian Coastal Administration, and several high-speed craft companies. An overview of the number of persons interviewed is provided in Table 1.

Those interviewed from the Norwegian Maritime Authority work with safety, law, international affairs, inspection, and the working and living environment, while the representatives from the Norwegian Coastal Administration have responsibilities within administration and safety. In the high-speed craft companies, we interviewed 12 persons from the shipowner's offices, who are managing directors, quality and

Table 1. Empirical foundation for the study.

Organization	Persons interviewed
The Norwegian Maritime Authority	15
The Norwegian Coastal Administration	4
High-speed craft companies	28
• Shipowner's office	12
• Crew	16
Total	47

safety managers, operating managers, and transport coordinators. The remaining 16 interviewees are captains, engineers, and seafarers on the high-speed passenger vessels.

The interviews took place at the interviewed persons' workplaces, including offices and vessels in different Norwegian regions. One to three researchers conducted systematic conversations lasting for half an hour to two hours with one or more participants (semi-structured group and single interviews). We used a digital recorder, and the interviews were later transcribed verbatim. The transcriptions are the source of the quotations in Section 4. In the interviews, we asked the representatives to describe how regulators, the ISM code, management, and other factors influence their work and ability to perform safe operations. They were not asked to reflect on the different accident types, so we undertake this task ourselves in Section 5.

The analysis of the interview data is performed by dividing the data into three subgroups based on the levels from Rasmussen's (1997) risk management chain depicted in Figure 2: regulators, management, and crewmembers. In the next section, we analyze each of these groups, looking for the themes and topics highlighted by most or all of the informants within the group. This allows us to compare the viewpoints of each group to see how the link between regulation and safety changes as we move from the blunt to the sharp end. The knowledge acquired from Section 4 enables us to discuss the regulations' influence on personal injuries and ship accidents in Section 5.

5. Results and analysis

In our interviews, selected regulators, ship office management, and crewmembers explain their views of the ISM code in relation to safety and safety management, practices, and values. How the regulation prevents personal injuries or ship accidents is implicit here but will be discussed directly in Section 6.

5.1. Regulators

This section addresses how the regulator representatives describe (1) the ISM code's implications for their own practice and what they see as its (2) positive, and (3) negative consequences for safety management in the shipping companies.

5.1.1. Consequences for regulatory practice – mostly positively valued

When a regulator performs audits to verify whether a company's SMS complies with the ISM code, he or she is required not to consider the quality of the system but to oversee that a system is in place and is followed. Most regulators are ambivalent regarding this (see more in Section 5.1.3).

> If they have a system that works for them and that satisfies the code, then we have nothing to add. But, if they have a system that no one uses, then it's another matter.

More positive experiences are related to the fact that the ISM code has revealed a new *advisory* role for regulators. They value their ability to make recommendations and provide guidance in ISM audits. This gives the regulator the possibility to suggest simplifications of SMSs.

> I don't think that it's a goal to come back with a lot of nonconformities after an ISM revision, not at all. […] I think it's important to make them aware of parts of the system that they don't need and should omit.

5.1.2. Positive consequences of the ISM code for the shipping companies

Overall, the regulators perceive that the ISM code, with the resultant SMSs, has led to safety improvements in the industry. It has pushed forward the development of much-needed SMSs among the shipowners, as they earlier had variable and sometimes lacking SMSs. Today's systems are mostly in accordance with the regulations, even though they vary in size and practical use.

> ISM's a very useful tool, and the ISM code isn't extensive, it's very limited and general. In a way, it's up to the ship owners to align it with their activities.

5.1.3. Negative consequences of the ISM code for the shipping companies

Most of the interviewed regulators reflect upon the increased administrative burden associated with the SMSs. Importantly, but not surprisingly, they are concerned that the SMSs can be too extensive with too many procedures to handle. They fear that this can lead the crews to lose respect for the system or disregard important parts of it.

> Safety management systems can be too large, too many procedures to take into account, procedures for the simplest of operations. The more dangerous things can be overlooked. Maybe we should've omitted some and kept the important ones.

The regulators admit that the paperwork demands considerable attention from officers on board and worry that it can challenge what are regarded as core tasks.

> The captain has to be released to go below to do the paperwork, then up again to navigate the vessel, and then down again … The system can be too demanding for a ferry crossing a fjord with four crewmembers on board.

Practically, all vessels use computer software to register and document the information that is required by the ISM code. Although this eases some of the workload, regulators also note that the use of IT tools can foster a kind of 'ritualization' of safety work and a sense of false security. For example, risk appraisals can be produced in a 'copy–paste' manner, in which no actual risk considerations are made. Regulators call this 'window dressing', which has little actual effect on safety.

> Then we got the computer-based way of doing risk appraisals. One could just push the button. It looks very impressive. But there's a danger that you just push 'print' the next time you need it. […] If it isn't reconsidered regularly, this might lead to complacency.

Furthermore, the regulators express concern about a negative effect of functional requirements in general. Safety-relevant issues can be ignored if no concrete requirements address a certain hazard.

> When I started, there was a problem with fishermen falling into the sea [without being able to climb back on board]. And I wondered, couldn't they just install ladders? The answer was that there was no requirement for ladders, and hence, they were not acquired.

The regulators wonder why collisions and groundings have increased in recent years.

> We have too many vessels colliding with quays. Why does this happen? We have functioning systems, as well as audits from the authorities that show few deviations, but still they collide.

In sum, the regulators' general impression is that the ISM code has led to the implementation of SMSs on a broad basis and that this has brought about positive changes related to safety. Still, some see non-intended consequences that could also compromise safety, for example, SMSs can increase the administrative workload and the 'ritualization' of safety.

5.2. The shipowner's office

Management representatives are mostly positive towards the ISM code and the SMSs that they have created, as (1) they make the company invest in safety and (2) they formalize and systematize the safety work. Nevertheless, they also see negative aspects with the low safety resources, without connecting them to either personal or ship accidents.

5.2.1. More safety investments

The transport companies included in the study express that they have limited room for extra expenses. Due to the tendering processes that they have undergone, all costs have been thoroughly reviewed and minimized (confer the brief introduction to competitive tendering in Section 2.1). The departments of safety and quality at the shipowner's office are often responsible for the SMSs. These departments usually consist of one employee and a tight budget.

> Just now, an operations manager came to my office wondering why we needed money for safety work. Then you have to sort of defend why you need to spend money on it.

Some safety managers state that the ISM code can serve as a form of empowerment to defend the need for safety expenditures in their company. Still, some voice frustration about not gaining acceptance to raise the bar above what regulators consider the minimum level of safety. Most interviewed managers hope that the ISM code will make the counties include mandatory safety measures in future tenders. Managers confirm that companies cannot win contracts if they plan to spend more on safety measures than just what is legally required.

> The tenders usually refer to regulations – as long as it's within regulation, it's approved. But, to me, that's a reactive approach to safety. You do nothing more than you have to.

5.2.2. Formalization of safety

At the same time, the company representatives express that the ISM code has led to a strong formalization of safety work.

> There is too much office-related work. We have become executive officers, all we get is a computer in front of us, and we deal with the case from A to Z. I see that as a very poor solution.

This formalization is also viewed as positive by the managers because it involves a more systematic approach to safety management and the seafarers have (albeit slowly) grown accustomed to a larger amount of paperwork. Nevertheless, there seems to be considerable friction between the formal and the informal aspects of work. One of our informants, with a background as both a captain and an administrator, reflects on the challenges he saw at the time when formal routines were implemented, although autonomy was the ideal:

> If you go back in time, the ISM code involves going into something new, like with the quality assurance system: you have to document what you do. And that's a clash between an old and a new culture. My experience after all these years is that a captain like me would say, 'ISM – what the hell is this? I've done this all my life, and now I have to do my job according to the writing on a piece of paper?' There was a lot of resistance, and some even quit sailing because of the ISM code.

The interviews with crewmembers show that this friction is still very present among seafarers, as the next section elaborates.

5.3. Crews

Many crewmembers on the vessels express strong opinions about the ISM code and their SMSs. Most of our operative informants are quite negative towards the effects of the ISM code, feeling that it may actually have worsened safety. Others are more neutral in the sense that they believe the ISM code has had little effect. A third category of viewpoints consists of those that see positive safety effects of the ISM code.

5.3.1. Neutral views of the ISM code's consequences

Every crewmember interviewed feels that the SMSs have become too extensive and that it is difficult to keep track of the various rules and procedures. Yet, many crewmembers do not see a link between SMSs and work practice at all. Although SMSs have been implemented, the work performance has continued unchanged.

> You know what's in the procedures and the [SMS], but anyway you do things in your own way in the daily business.

However, the neutral (as the negative) view of the ISM code also involves violating procedures on a regular basis and shows a form of indifference toward SMSs:

> When so much is about 'safety' you don't give a damn. [Laughing] It's clearly not seafarers who've made these systems.

5.3.2. Negative consequences of the ISM code

Others, especially navigators, highlight a more negative view. During an interview, one navigator turns the pages of the SMS and finds irony in the fact that he cannot comply with the procedures with which he really agrees. The company's SMS says the navigator must have the navigation in absolute focus. He is to monitor the sailing, he is to not use the phone if the water is not clear, no irrelevant persons should be on the bridge, and the communication on the bridge should only be about navigation. However, all navigators say that they always receive calls, from customers, the next crew, maintenance operators, the company office, and so on. The navigator in

charge has to find stand-ins for crewmembers who call in sick, answer emails, write in the logs, and fill in documents. Most navigators are frustrated by all the documentation that they have to do '… for the managers to cover their backs'.

> … The office is supposed to be there for us, but it is rather the opposite. We're here for the office.

Some point out that SMSs makes them 'dumber', because they have to comply with instructions instead of thinking or using their competence. They are concerned that many procedures lead seafarers to become less dedicated and act only upon the hazards that have already been defined.

> Our [SMS] says how to mark out the course for each of the company's schedules. But it doesn't consider stream or weather. And, experienced navigators want to – and do – choose a course according to wind and stream. But that's not complying with the [SMS].

This is directly linked to the notion of seamanship and the seafarers' perceptions of their own competence. They see that the SMSs and electronic equipment demand a new type of competence that is disconnected from the old practices and is causing the ideals of 'good seamanship' to lose significance:

> Before, you had to be able to find your way – one criterion was that you were familiar with [your region]. Now you have to know about papers and computers and all this.

> It's over. There's nothing called seamanship anymore. Everything … the seamanship is between two loose-leaf binders.

5.3.3. Positive consequences of the ISM code

There are also positive perspectives of how SMSs affect work practices. The seafarers are generally satisfied with procedures that make their everyday work easier and safer – such as electronic maintenance systems and mandatory resting periods, risk analysis, personal protective equipment, HSE meetings, and routines for emergency training.

> I've worked here in seventeen years now, so I've felt the difference. When I was a boy we didn't have any [emergency] training.

Many of the informants also report a change in attitudes and perceptions after they 'started with all these loose-leaf binders'. They point out that the paper systems have made them think more systematically about safety and understand more of the safety consequences of their practices. Therefore, they act in a safer manner. Although many perceive that they perform their work in the same way as always, some also think that they and their colleagues are more focused on safety:

> I feel that safety is much better taken care of now than before. It was more at random before, even though it was ok back then, too.

When asked if this has led to a safer work environment, one ship captain says:

> I sometimes reflect upon that. We've got the papers in order, but is it really better? Do we only produce paper? […] The Maritime Authorities statistics are as bad as before, we run on shore just as much as we did before.

Seafarers, trying to explain the many ship accidents happening despite improved safety management, underline the negative aspects of regulation in addition to the reduced staffing and resources on the vessels due to competitive tendering. The interviewed crewmembers are especially irritated by the tight time schedules set by the counties and the incorporated fines, resulting in seafarers becoming occupied with financial rather than safety priorities.

> Our schedule is a stress factor. They plan for it to be a stress factor. Everything is on the spot, you have no margins.

All the crewmembers express that the passenger vessels are run safely – some say *because of* and others *in spite* of the SMSs. In general, they describe the safety systems as a 'necessary evil', which improves safety in some ways but at the expense of good seamanship and practical attention and, therefore, might decrease safety in other ways.

6. Discussion

In this paper, we explore safety management regulation's impact on safety management to prevent individual and ship accidents. The last section described the ISM code's practical consequences through the views of Norwegian regulators, shipowner management, and crewmembers on passenger vessels. Consequently, we have gained insights into how the international regulation is translated into safety measures by the actors on different levels of the socio-technical system (Figure 2, Rasmussen 1997). Now we will discuss how the ISM code influences safety management (1) positively and (2) negatively, to come closer to revealing (3) the consequences for personal and ship accident prevention.

6.1. Fighting economy: safety regulations raise safety levels

SMSs are generally perceived to increase safety awareness – in this study as well as in earlier research (Lappalainen, Kuronen, and Tapaninen 2014). Other positive effects reported in our interviews – on all levels – are valuable routines, regular emergency training, a systematic approach to qualifications, and more features meant to stimulate safe and competent work practices.

A positive aspect emphasized in most interviews is that the ISM code makes shipowners raise their safety level. This does not prove a *high* safety level, as the general state in sea transportation still favors cost-efficiency [discussed for example by Størkersen (2015); Bhattacharya (2012); Lappalainen, Kuronen, and Tapaninen (2014); DeSombre (2008)]. In Norway, county authorities give contracts to the cheapest tender for passenger transport, making the tenderers reduce their costs and increase their efficiency. Production priorities tend to trump protection – as Reason (1997) would say – but safety regulations have made shipping companies prioritize protection where it is mandatory [also reported by Lappalainen, Kuronen, and Tapaninen (2014); Bhattacharya (2012); Knapp and Franses (2009)]. The companies report openly that they cannot afford to implement safety measures that are not directly related to government requirements.

In addition to the measures that the companies implement due to regulations, the company boards might be persuaded by the personnel to make safety investments. Crewmembers and safety management point to the ISM code as a source of power

in arguing for the importance of safety measures. This illustrates that the regulation serves to heighten the minimum safety level to which the companies adhere.

However, the logic of raising the minimum level and compliance stands in contrast to the ISM code's intentions for companies to be 'self-regulated' and 'self-thinking'. Many interviewees want the regulators to demand higher safety levels from the companies, but when the ISM code requests 'procedures to ensure safe operation of ships', the *companies* are expected to decide what is safe enough. Still, most of the initiatives in practice lie with the *regulator*. The regulators know of measures to pursue the safety priority but cannot act on them due to a lack of support from trade-focused government and interest organizations (Størkersen 2015). Our study indicates that the move from regulator responsibility to companies taking total safety responsibility has not yet been fully achieved in maritime transportation. This is discussed further in the next section about the bureaucratization of safety management.

The consequences of the ISM code discussed in this section seem to contribute positively to safety; at least, is it hard to see that these aspects should increase the risk of any accidents.

6.2. *Unintended negative consequences of the safety management regulation*

Regulators, managers, and indeed crewmembers describe most companies as having SMSs that are too complex, leading to extended formal work and a culture clash.

A comprehensive management system demands much administration and formalization. The interviewed managers experience being forced to be computer clerks. On the vessels, our study, like others (Bhattacharya 2012; Lappalainen, Kuronen, and Tapaninen 2014), demonstrates that the increase in administrative work is a source of frustration for the crewmembers, since much of it is viewed as unimportant tasks that take away time from safety-critical 'core tasks'. The paperwork load is especially heavy for navigators, who consequently have few opportunities to practice direct safety guidance and navigation. In addition, earlier research (Power 1999; Dekker 2014) emphasizes that attention to paperwork can turn resources and attention away from the actual operations.

Further, this formalization causes a clash between compliance and traditional professional culture. As we have seen, the SMSs are implemented as detailed rules, commonly described as overly static compared with the situational variation (e.g. weather conditions). The ISM code can be argued to have contributed to a *bureaucratic culture*, using the typology of Westrum (2004). In a bureaucratic culture, compliance with external requirements is likely to be the goal of safety management. This means that the commitment to safety is driven more by extrinsic than by intrinsic motivation. Crewmembers experience that the SMSs displace the common sense incorporated into *good seamanship*. The SMSs formalize safety, involving a strong presence of safety professionals with a 'model monopoly' that can marginalize practical knowledge (Almklov, Rosness, and Størkersen 2014). The crewmembers point to an antagonistic relationship between traditional seafarer values – to make independent decisions according to the weather and context – and formalities – to perform work according to the rules. In practice, neither the management nor the crewmembers are urged to be 'self-thinking', even though that was a goal for the ISM code. Studies find that the ISM code has contributed to better communication in the Finnish maritime industry (Lappalainen, Kuronen, and Tapaninen 2014)

but has created a large gap between managers and crewmembers on tankers (Bhattacharya 2012). Our results suggest a gap between administrative- and practical-focused personnel on all levels. Bureaucratic safety discourses disempower the practitioners and their local knowledge. Overall, the traditional ideals of what it means to be a good seaman seem to be at odds with the formal SMSs.

These negative aspects of the ISM code can influence accident prevention differently. The administrative burden is easily associated with less concentration on navigation, which can lead to ship accidents. The absence of seamanship and the experienced pressure for 'unthinking' compliance can lead to both kinds of accidents as sailors lose their professional competence, but perhaps compliance can also prevent individual accidents, assuming that it empowers crewmembers' planning.

6.3. How the ISM code affects the risk of personal injuries and ship accidents

The discussion so far shows that earlier research results are also valid for Norwegian passenger transportation: the ISM code can exert a positive influence by increasing safety investments and safety awareness, but it also has negative effects that cause crewmembers to fight against paperwork, limited concentration, limited manning, and many tasks. How this is connected to accident prevention is unclear, so now we want to consider the ISM code's relation to the ship accident increase and personal injury decrease in Norwegian waters (Maritime Authority 2014).

Personal injuries or individual accidents happen to crewmembers during work or other activity on the vessel. According to Reason (1997), personal injuries are often related to slips and lapses. Our data from companies and regulators show that even though the maritime SMSs are complex (producing less rule overview and more paperwork), the crewmembers largely benefit from improved safety awareness and better-structured routines. Even though most crewmembers underline the importance of seamanship and their own considerations, their statements also suggest compliance with thought-through procedures for maintenance, resting periods, personal protective equipment, safe job analysis, and emergency training. Such routines unite the rationality of seamanship and the SMSs, the new and the traditional way of working at sea, and might prevent hazardous operations that earlier led to broken bones, clamped fingers, and suchlike. These operations are on-board operations that are unequal to navigation. They are mostly related to personal accidents and can more easily be regulated by simple procedures. Consequently, the ISM code might have contributed to a decrease in slips and lapses on Norwegian passenger vessels.

Navigation, on the other hand, can result in ship accidents if it fails. Ship accidents are more likely to be organizational accidents (in the terminology of Reason (1997)]). *Navigation* is often the mediator between unfavorable organizational conditions and the accident, meaning that a navigation error is often a cause of ship accidents. Our studied companies' SMSs have formal procedures for safe navigation, for instance to prepare each sailing as if it were the first, use a crewmember as a watchman, keep all focus on the navigation, and so on. However, our interviewees explain that these procedures are seldom complied with, as competing market-related procedures are prioritized. According to the procedures, the navigator is to answer emails from managers and calls from customers (about keeping to the schedule), to organize extra manning, and to fill in logs – and all this has to be carried out under navigation to leave time for sleep after the watch duty. It is hard for a navigator to concentrate on navigation under such disturbing conditions. It seems that the

Table 2. ISM code intentions and industry responses.

Regulatory intention	Industry response
Self-regulation	Compliance-driven
Continuous improvement	Minimum standards for safety
Safety culture	Administrative structures (procedures)

negative sides of the ISM code – extensive proceduralization – disrupt navigation more than they disrupt other activities. Following navigation procedures and at the same time focusing on navigation might be possible if the navigators' tasks are reduced or reorganized. Additional manning could partly solve the problem, but the companies cannot grant this.

Our results therefore indicate that the ISM code contributes to safety in some activities on the vessels, as intended. SMSs are useful for preventing individual accidents. When it comes to ship accidents and navigation, on the other hand, the negative effects from SMSs and economic competition have more influence, so the possible positive effects of the ISM code are not apparent.

Summing up, there seems to be a mismatch between the regulator's intention for the ISM code and the industry's adaptation to these regulations. This mismatch is described in Table 2.

Somewhere along the risk management chain of Rasmussen (1997), the regulatory signals from the ISM code seem to change into practices that are based on a rather different philosophy of safety. Due to this 'mutation' of the ISM code's intentions, it influences the risk of personal injuries and ship accidents in different ways. Safety management practices directed at personal injuries often take the form of work procedures. Such measures are 'cheap' in the sense that they require little or no economic investment from the company. The risk of ship accidents are to a greater extent influenced by technical measures and the level of manning. These are measures that require either investment in design and equipment or increases in operating costs. In a context of heavy competition, shipowners' efforts are therefore likely to be aimed at the procedural (personal injury) level.

7. Conclusion

In this paper, we have explored how safety management regulations influence safety management practices and their prevention of personal injuries and ship accidents, exemplified by the ISM code's consequences for Norwegian maritime passenger transportation. We find that the ISM code has positive and negative implications; it has led to greater safety awareness and a higher safety level in the industry but also more administrative work and frustration related to professional competence and compliance. This is in line with earlier research [by for instance Bhattacharya (2012); Lappalainen, Kuronen, and Tapaninen (2014); Bieder and Bourrier (2013); Almklov, Rosness, and Størkersen (2014)], but Norwegian maritime passenger transportation seems to be particularly suitable as a case to show how employers prioritize economy instead of innovative safety measures. In addition, Norwegian maritime transportation has increasing rates of ship accidents but improving rates of personal injuries, and our results propose an explanation for this paradox: the safety management regulations appear to work when they contain knowledge and routines

that seem rational to the personnel, provided that the personnel have the resources to comply with the procedures. However, during watch-keeping on the bridge, the ISM code and market aspects give navigators too many disturbances to follow the safety procedures and concentrate fully on the navigation. Thus, at least in this industry, the SMSs might prevent individual accidents, such as personal injuries, but not ship accidents, such as ship groundings.

Possible approaches for companies to avoid ship accidents could be to simplify the procedures and minimize the disturbances for the navigators, for example by allocating more of the administrative tasks to the onshore organization. Regulators could actively address the external conditions. For example, tendering processes could include stronger safety criteria. These would reduce the pressure to make cost reductions and, at the same time, ensure equal competition between the bidders. Regulators could actively pursue the concretization of safety criteria in cooperation with other public bodies.

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Notes

1. The full name of the ISM code now is the *International Management Code for the Safe Operation of Ships and for Pollution Prevention*.
2. Several organizations, associations, and conventions are important for international maritime law, such as the International Maritime Organization, the International Labour Organization, and Paris MoU, but this paper will not provide an overview of these.

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When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge?

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ABSTRACT

In this paper we explore the proposal that knowledge generated by safety scientists may displace or marginalize existing local or system-specific safety knowledge embedded in operational practices. The proposition is based on theory about relationships between knowledge and power, complemented by organizational theory on standardization and accountability. We suggest that the increased reliance on self-regulation and international standards in safety management may be drivers for a shift in the distribution of power regarding safety, changing the conception of what is valid and useful knowledge. Case studies from two Norwegian transport sectors, the railway and the maritime sectors, are used to illustrate the proposition. In both sectors we observe discourses based on generic approaches to safety management and an accompanying disempowerment of the practitioners and their perspectives.

We discuss some contributing elements to this development: for example, the roles of external and internal HSE-specialists and the increased importance of international standards. We propose that the search for broad generalizations and the widespread adoption of cybernetic thinking in safety science may resonate with societal trends towards standardization and bureaucratic control.

We conclude that safety scientists, safety professionals, and organizations that hire safety professionals need to be sensitive to the possibility that their well-intentioned efforts to promote safety may lead to a marginalization of local and system-specific safety knowledge.

1. Introduction

The aims and scope of the journal *Safety Science* include the following statement: "*Safety Science* will enable academic researchers, engineers and decision makers in companies, government agencies and international bodies, to augment their information level on the latest trends in the field, from policy makers and management scientists to transport engineers" (Safety Science, no date). This statement corresponds to the common-sense notion that the applied sciences produce information that can be disseminated to practitioners. The practitioners will increase their knowledge base and, as a consequence, increase their capacity or power to handle safety challenges. Knowledge is seen as additive and empowering.

The purpose of this paper is to explore an alternative view on knowledge and power. We propose that the introduction of management regimes based on generic safety management principles and international standards may displace or marginalize existing local and system-specific safety knowledge. According to this proposition, the knowledge produced by safety scientists and propagated by safety professionals is not just added to the existing knowledge of the practitioners at the receiving end, and it is not necessarily empowering when it reaches the practitioners (see also Daniellou et al., 2011). Generic safety knowledge may be embedded in a discourse (Foucault, 1972; Jørgensen and Phillips, 1999) in which the local and system-specific knowledge of the practitioners is marginal, irrelevant, or even meaningless. Safety professionals may gain a model monopoly (Bråten, 1983; 2000) in their interaction with practitioners. This will not only put the practitioner in an inferior position with regard to power; it can also obstruct mutual learning in the relationship between safety professional and practitioner. When organizations adopt management regimes based on generic safety management principles, this also influences reporting lines and regulation. We specifically discuss how international standards and regimes of accountability built around these principles act as drivers of professionalization and compartmentalization of safety. In this discussion, standards for how work is performed and safety is managed are our primary concern, and less so technical standards. The intricacies of how technical and process standards are connected make up an interesting topic in itself that should be explored elsewhere. Almklov and Antonsen (2010) note, for example, how standardization of

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components and parts of electricity grids is important for management to control work on it through standardization and accountability based methods.

In our discussion, we contrast generalized theoretical knowledge with knowledge that is more specific to local contexts. Where work is performed, people gain experience of the peculiarities of the technological systems and their surroundings and how to work in the specific context. Some of this knowledge is personal (Polanyi, 1958), as the know-how and perceptive skills of expert practitioners often involves non-verbal skills (see Dreyfus and Dreyfus, 1986). The knowledge may be shared by a limited community of practitioners (Lave and Wenger, 1991), or documented in rules and procedures that are specific to limited contexts[1]. The focus on the tacit dimension of experience based local knowledge does not mean that it is unrelated to more abstract and generic procedures. Often, experience-based knowledge is essential in order to make more formalized systems work smoothly. Still, throughout this paper we will refer to the local and system-specific, experience-based technical and practical knowledge forms that are specific to singular contexts, in contrast to generic formalized management principles that have been designed to be movable across sectors and systems.

The theoretical basis for our discussion will be reviewed in Section 2 of this paper. Our study's methods are described in Section 3. In Sections 4 and 5, our propositions are illustrated by case studies from two Norwegian transport sectors, the railroad and maritime sectors. In Section 6, we summarize the results across the sectors and discuss the role and responsibilities of safety science and safety scientists with regard to marginalization of local and system-specific knowledge and disempowerment of practitioners.

2. Theory

In the exploration of the foundations of knowledge and power in safety science, we use theories of how power and knowledge are connected. In the empirical section, we observe a change in the distribution of power between practitioners and specialists, and how this change is influenced by specific regulatory practices and organizational discourses. In the following, we present some of the key inspirations for this discussion.

2.1. Power and discourse

A central premise for this paper is that social phenomena are socially constructed, and they are always in the making. The ways in which we speak and write about things do not neutrally reflect the world. Discursive practices play an active role in creating and changing identities and social relations (Foucault, 1972; Jørgensen and Phillips, 1999). A particular discourse (for instance, a particular way to speak and write about hazards and safety) may gain hegemony. It then becomes taken for granted or naturalized. As a consequence, alternative ways to speak and write about things may become irrelevant or meaningless. In this way, discourses may become carriers of both knowledge and power, and specific discourses may reflect the interests of particular groups.

In the present study, we want to explore whether knowledge produced by safety science meets the practitioners in the form of new discourses – or hegemonies – about safety. To the extent that this is the case, we want to explore whether the existing safety knowledge of the practitioners is marginalized in these new discourses. As a first step, we will suggest that there exists a safety discourse that emphasizes accountability and standardization.

[1] See Hale and Borys (2013 a,b) for a discussion of rules in safety management.

2.2. Accountability, standards and knowledge mobility

There are some overall societal and scientific developments related to the discourse of safety discussed here. First, the current regulation of safety should be seen in context of the "Audit Society" (Power, 1997; see also Power, 2007). In recent decades, societies, institutions, and companies have developed an intense interest in formalized methods for checking and follow-up activities. There are "deep-seated institutional pressures to make risk management practice auditable" (Power, 2007: 153). Both in the public and private sector, there is an increasing tendency to regulate and follow up on safety through audits and accountability regimes (see, for example, Hohnen and Hasle, 2011).These methods are means of providing transparency and control by

> *... spelling out institutional procedures and decision rules that would otherwise be implicit, and establishing paper audit trails or their electronic equivalents. Those developments allow auditors and inspectors of various kinds – the exploding world of 'waste-watchers, quality police and sleaze-busters'* (Hood et al. 1999) *– to verify that the written rules, procedures and protocols have been followed* (Hood, 2007: 196).

Safety management has become subsumed by the more generalized accountability-based mechanisms of governance that dominate today. An example is the trend towards increased reliance on internal control and self-regulation, where companies are expected to have transparent standardized systems for control. For external auditors and authorities, it is primarily the *systems* that are subject to control and regulation (Power, 2007). In contrast to the command-and-control structures of the last century, in which leaders had more holistic responsibilities and authority, the regimes of accountability are narrowly concerned with the specified items by which individuals at different levels are held accountable.

Standardization is a method of making accounting objective and excluding personal judgment (Porter, 1995: 90–98). When tasks and targets are standardized and measurable, performance can be compared across sites. Moreover, it can be done with the "mechanical objectivity" (Porter, 1995: 4) of measurement and accounting-based methods. As such, standardization is an intrinsic element of the audit society. These developments are also crucial elements in the rise of management as a profession, and "managerialism" as a way of governing companies and institutions (see Power, 2007; 152ff; Pollitt, 1990)

International safety standards should be seen not only as attempts to ensure safety and interoperability but also as a means of making safety work transparent across contexts. If workers perform tasks as the standards prescribe, they are compliant, at least from an accountability perspective, and this compliance is transparent to regulators and others without having to further investigate details of the local setting. Standards are a means of making information mobile across contexts (Bowker and Star, 1999; Latour, 1987; Almklov, 2008).

When safety science is introduced into organizational practice as safety management systems or regulations, it is, as we will demonstrate, formulated within the dominating discursive modes of accountability and standardization. These, we will propose, tend to favor systematic disciplinary knowledge over local unique personal expertise, in terms of what is regarded as valid knowledge.[2] One of Antonsen's (2009: 1123) informants, in a study of culture and safety on offshore supply vessels, illustrates this neatly:

> *You know, good seamanship, it is tragic, it is about to disappear completely. That expression, 'good seamanship', it doesn't exist*

[2] For a discussion of standards as "recipes for reality" and the related power dimension, see Busch (2011).

anymore, because everything that is to be done, has to be written on a list. You are not supposed to use good seamanship and common sense, you are supposed to use check lists, procedures and maintenance lists. That's what it's all about. And I know this is a source of great annoyance to the guys on the deck.

Decisions and activities enter the systems of accountability by being performed and described according to standards. The bureaucratic methods of accountability depend upon activities and situations of each local context being translated into slots on the accountants' sheets.

In the present study, we explore whether a similar marginalization of local and system specific knowledge could be observed as the safety regime's focus on accountability and/or standardization reaches the railway sector and the maritime sector. We will also explore whether the implementation of standards causes a shift in the power-balance between the actors in the local operational context and the generic expertise and control functions. This exploration will be informed by Bråten's theory of model monopoly and principal-agent theory.

2.3. Model monopoly

Bråten (2000: 105) points out that information is only useful to the extent that we have appropriate models that enable us to process and utilize that information. A *model monopoly* occurs when the domain of discourse is delimited in such a way that only one actor has access to a rich repertoire of relevant concepts and ideas, whereas the other actors are lacking such symbolic resources. We may refer to the former actor as model-strong and the latter as model-weak. Being the weak part in a situation characterized by model monopoly obviously leads to powerlessness. One may even have extensive knowledge about the issues at stake, but still be unable to utilize this knowledge effectively in a dispute. Model monopoly implies that the model-strong actor has a monopoly on the model, but it also implies that the model has a monopoly on the model-strong actor. The model-strong actor is restricted to a single, closed perspective, which excludes alternative interpretations of the situation.

According to Bråten (1983: 25; 2000: 105), attempts to share model power are likely to preserve or increase the power difference. The model has usually been developed to reflect the perspectives and interests of the model-strong actor. The model-weak actor is thus led to adopt the perspective of the model-strong actor, and this perspective is tacitly accepted as the only valid perspective on the issue at stake. Moreover, by sharing parts of his model, a model-strong actor increases his ability to simulate the responses of the model-weak actor, and he even gets some control of the capacity of the model-weak actor to simulate other actors' reactions.

The key is to resolving a model monopoly is to cancel one or more of the conditions that promote it (Bråten, 1983: 26; 2000: 21). This can be done in several ways:

1. Re-define the domain (universe of discourse).
2. Introduce complementary or competing perspectives that offer alternative or transcending terms.
3. Develop pertinent knowledge on the model-weak actors' own premises.
4. Evoke rival knowledge sources, or take a meta- or boundary position, crossing the boundaries of the domain.
5. Be aware of one's own tendency towards consistency and conformity with a monolithic perspective that silences the question horizon.

2.4. Agency theory

A common topic in political science and economics, is the dilemma that may occur when "an activity or the power of one of the actors—*the principal*—is delegated to [..] another individual—*the agent*—because of his specific competence" (Trontin and Béjean, 2004: 122; see also Eisenhardt, 1989; Rosness et al., 2012). In this paper, we discuss the roles of safety professionals as intermediaries and as agents who aid the sharp-end workers with implementing and interpreting safety management systems. The dilemma is that the interests of the agent (for example, the safety consultant and their customers/principal), are not perfectly aligned. The consultant may, for example, be interested in landing a follow-up contract as well as performing the ordered work, or maybe of making the safety management systems more generic to ease his own work. This may be a part of the explanation for the development of a more generic, standard-based approach to safety.

In the present study, we explore whether a model monopoly may occur when safety science reaches practitioners in the context of new regulatory regimes, focusing on accountability and standardization. We will also explore whether practitioners may become the weak part in principal-agent relationships with authority representatives and consultants, due to information asymmetry.

3. Method

The overall approach in this study is abductive in the sense that cases are "interpreted from a hypothetic, overarching pattern, which, if it were true, explains the case in question" (Alvesson and Sköldberg, 2009: 4). We include two complementary cases because abductive explanations need to be strengthened by new observations.

Though we will focus our discussion on these cases, the paper is inspired by a longstanding interaction with Norwegian transportation and infrastructure sectors, and observations from diverse projects (Almklov and Antonsen, 2010, in press; Antonsen et al., 2010; Blakstad et al., 2010; Guttormsen et al., 2003; Rosness, 2008, 2009, 2013; Størkersen et al., 2011)

The study is guided by the analytic model shown in Fig. 1. Our main interest is what happens when the results of safety science meet the practitioners (the horizontal arrow). Our focus is on knowledge and power, which we consider inseparable. However, in order to construct a plausible account of this, we propose that it is necessary to take into consideration (1) current societal trends towards accountability, standardization, and professionalization, and (2) the actions and practices of intermediaries such as regulators, consultants, and internal safety departments.

The first case is a historical analysis of the Norwegian railway sector, with emphasis on the last twenty years. The study draws heavily on a recent history of Norwegian railways (Bergh, 2004; Gulowsen and Ryggvik, 2004), but is also based on primary documents (Traffic Safety Rules, a Safety Handbook and public accident investigation reports), interviews, consulting experience (e.g., *Ref Blinded*), a study of rule development (*Refs blinded*) and informal discussions with railway personnel. The historical study is supplemented with recent interviews focusing on regulatory issues in the ongoing RESCUE (*Regulative rationalities and safety culture*) project.

The second case study is a snapshot of some maritime transporters' view of safety work today. The data for this part is drawn from two projects: RESCUE, which is still on-going, and the recently finished Safety in Cargo Shipping (see Størkersen et al., 2011), which was conducted for the Maritime Directorate of Norway. Together, these projects contain interviews with around

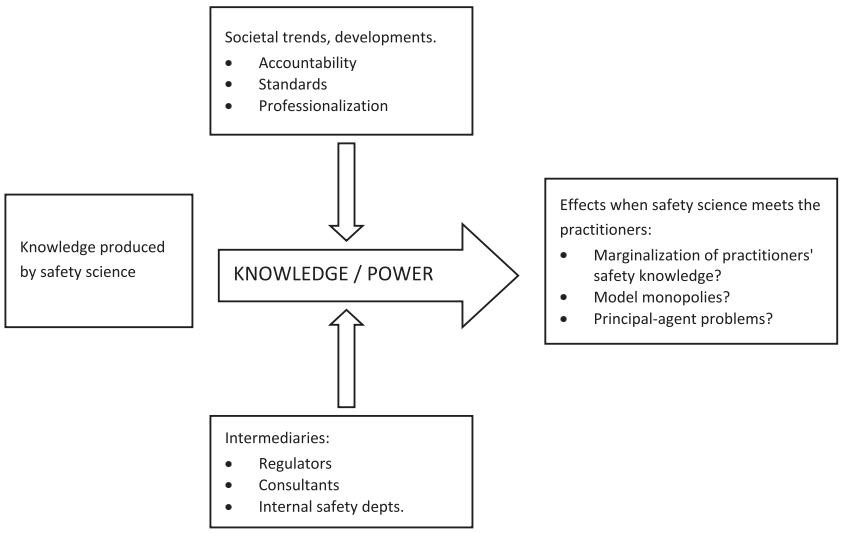

Fig. 1. Analytic model.

80 seamen on passenger boats and cargo ships. Safety in cargo shipping also included around 300 h of observation on cargo ships. Important information for the present discussion also comes from interviews with managers, interest organizations, and authorities conducted in these projects. We have, however, only analyzed and employed the most relevant interviews for this paper, the interviews where the topics of concern were explicitly addressed. Though these most relevant interviews are extensively quoted, they are also supported by observations and interviews throughout the projects. Quotations should not be seen as evidence themselves, but as illustrations of our insights drawn from the total body of interviews and observations.

Longstanding and recursive interaction with the industries gives opportunity for triangulation, cross checking, and discussion of our observations. Qualitative interviews combined with document studies and surveys are also methods that give an explorative edge, the opportunity to uncover unexpected phenomena, while retaining the possibility of checking for generalizability. Since the data are drawn from independent projects, they give different angles and at least an element of confirmation of findings. In sum, we are convinced that our findings are robust (see Section 6.6.), but their generalizability to other sectors and countries needs to be explored elsewhere.

4. Confrontations between two safety regimes in Norwegian railway administration

The first case is a historical account of confrontations between two safety regimes (i.e., two constellations of knowledge, norms, and formal authorities) on Norwegian railways.[3] We shall contrast "the old regime," centred on the distinctive characteristics on railway technology and operations, with the "new regime," based on generic safety management principles. We shall then outline a series of confrontations between the two regimes.

4.1. The old regime

The old regime was as old as the railways themselves in Norway. The first public railroad, which was opened in 1854, adopted technology and safety rules imported from UK. The regime has evolved over time, as a function of new technological opportunities and learning from accidents. Regarding knowledge content, the old regime focused on the risks peculiar to railways and the specific technical and administrative means to keep these risks under control, such as signalling systems and traffic safety rules. This can be illustrated by the chapter headings and associated maxims from a book manuscript written between 1957 and 1961 by the head of the safety office of the Norwegian State Railways (NSB), shown in Table 1. Most of the topics, and nearly all the contents of this book, are specific to railway operations.

This knowledge was considered core competence and a marker of identity among NSB employees. In particular, mastery of the traffic safety rules was a status marker because it was precondition for holding a number of positions, such as train driver, rail traffic controller and train dispatcher. These bottom-up safety rules were closely connected to practice and experience and the rule set had grown rather complex over the years.

In the heyday of the old regime, the safety office had a prominent position in the organization, and its head reported directly to the managing director of NSB. The prestige and influence attached to this position went far beyond that of an ordinary staff function (Gulowsen and Ryggvik, 2004). Moreover, NSB was still a monopoly company encompassing infrastructure management, train operations, and regulatory authority in the area of traffic safety.

4.2. The new regime

"The new regime" refers to a competing constellation of safety management principles with associated knowledge, administrative systems, and organizational structure that entered the arena in the 1990s. The knowledge content and prescriptions for safety management associated with the new regime was generic. This is illustrated by the following excerpt from the public investigation report after the train collision at Åsta on January 4, 2000 (NOU, 2000: 30 p. 141, our translation). The text could equally well have been applied to an offshore petroleum installation by replacing the term "railway activities" with "petroleum activities."

> *Safety management refers to the activities of a safety-related character concerning organization, responsibility, processes, and resources that are required to direct and manage railway operations. Safety management is an organizational process that encompasses many steps, from strategic goals to evaluation of results.*

[3] The term "safety regime" is inspired by Slagstad's (1998) notion of "knowledge regimes."

Table 1
Chapter headings and maxims in the book " "Safety service at Norwegian railways during the first 100 years, 1854–1954" (Johannesen, 2007).

Chapter	Maxim
1. Introduction	Safety is the first and foremost requirement to public transportation
2. Laws and regulations	Safety is created by laws and regulations
3. Management of safety service	No safety without management
4. Signals and safety installations	Signal is symbol for safety
5. Safeguarding train movements on the line	No safety without a clear track
6. The trains' composition, equipment, speed, manning and inspection	Safety depends on the trains' composition, equipment, speed, manning and inspection
7. Shunting service	The safety of material and persons during shunting depends not the least on general carefulness and accurate judgements
8. Personnel	Well-equipped personnel warrants for safety
9. The relations of the public to safe operations	No safety for persons without personal carefulness
10. Accidents	Absolute safety does not exist
11. Safety conditions during the war 1940–1945	War is a threat to safety
12. Miscellaneous safety conditions	Safety has to be created under many different conditions and in many different situations

> *Safety management includes both the daily work, with checking that everything functions as it should, as well as a comprehensive assessment of risk and changes. These two forms are of different character. The daily work is of a practical nature and characterised by the need for somebody to be present all the time for safety to be adequate. The comprehensive assessment or the risk analysis is abstract and characterised by a comprehensive view and assessment of changes.*

In this text, the core knowledge associated with the old regime is "black-boxed." This knowledge is necessary to accomplish the objectives of safety management, but it is not visible in the text.

The new regime was associated with changes in authorities and power. The first step was the appointment of a Director of Health, Safety and Environment (HSE) in NSB in 1993. This step was a response to the introduction of internal control (enforced self-regulation) of HSE in the Norwegian work environment legislation. The head of the safety office was subordinated to this position, moved two tiers down the management hierarchy, and thus lost his direct reporting link with the managing director of NSB. The knowledge domain of the old regime was subordinated to the broader domain of HSE.

4.3. Confrontations, cohabitation and rapprochements between the two regimes

A major confrontation between the two regimes occurred after a train collision at Nordstrand in 1993. The Director of HSE issued a memo criticising the safety culture and the safety systems in NSB (Gulowsen and Ryggvik, 2004: 433, our translation):

> *. . . according to my impressions, the [safety culture] is characterised by a lack of clarity . . ., it has inadequate foundation in systems and management, it is technologically conservative, it is based on a very comprehensive set of rules which to some extent need modernizing and updating, it is not properly integrated in the HES philosophy and the internal control scheme.*

This was a head-on attack on the old regime, and in particular the safety office. The Director of HSE also chose to let an independent research institute investigate the Nordstrand accident, thus setting aside the in-house accident commission of NSB, which was led by the head of the safety office.

In 1996 the Norwegian State Railway (NSB) was divided into an infrastructure administration, The Norwegian National Rail Administration, and the new NSB, which was gradually reduced to a train operator. This step served to open Norwegian railway infrastructure for other train operators. At the same time, a separate regulatory authority, the Norwegian Railway Authority, was established.

The Railway Authority initially hired only two persons with a background from railway safety. The first two managing directors, as well as many of the staff, had a background from safety work in the petroleum sector.

The Railway Authority chose a regulatory strategy based on safety system audits rather than prescriptive requirements and inspections. Major audits were directed at the Rail Administration in 1998 and 1999. The conclusions were critical: in one of the audits the Railway Authority concluded that the Rail Administration lacked a visible safety management system (Gulowsen and Ryggvik, 2004).

In 1999 the Railway Authority introduced new safety management regulations that required the National Rail Administration and the train operators to establish a system for risk-based safety management. The Rail Administration responded to the new regulations by engaging two hired consultants to develop a safety management system. A *Safety Handbook* was released in 2000. The requirements in the Safety Handbook were mainly process oriented (e.g., requirements that technical modification and organizational change should be subject to a risk analysis) or outcome-oriented (e.g., risk-acceptance criteria).

After a train collision at Åsta with 19 fatalities on 4 January 2000, safety management at the National Rail Administration was severely criticized in a public accident investigation report (NOU 2000: 30 p. 203).

> *Safety-consciousness and safety management, which in other comparable sectors have been basic principles for many years, have not been implemented in the former NSB and later in the Norwegian National Railway Administration. When the incident-based form of safety management on which safety on the railways has supposedly been based has not been followed either, the result is a system that will only discover that there are basic inadequacies in the safety of a section of line when an accident happens on that particular line. . .*

> *In the view of the Commission, the Åsta accident occurred because of basic inadequacies in the Norwegian National Rail Administration with regard to safety consciousness and safety management. This means that the effect that serious and in some cases well-known safety deficiencies on the Røros line had on safety were neither analyzed nor followed up. These basic deficiencies in safety management apply to all the aspects of the Norwegian National Rail Administration's activities that the Commission has examined and must therefore be regarded as a serious system failure.*

The climate that emerged in the Rail Administration after the train collision at Åsta gave impetus to the new safety management system. The safety management discipline gained recognition, resources, and top management attention. The event and the public reaction also created an "unfreeze": i.e., a climate where people were willing to revise their unspoken values and basic assump-

tions and modify their practices accordingly. Both line managers and safety staff received training in safety management and risk analysis.

As a consequence of this new safety management regime, the Rail Administration has performed comprehensive risk analyses of all railway sections as well as numerous risk analyses related to technical modifications and organizational changes. The analyses have in several cases had an impact on decision making, by, for instance, forcing decision makers to clarify new roles and responsibilities before implementing organizational changes, or to modify the layout of new stations. Specialists in technical disciplines, such as maintenance management, found the safety management too general or abstract to give effective guidance to their daily work. They tended to rely on their own competence within their discipline in their efforts to maintain safety in their daily work while trying to be loyal to the requirements of the Safety Handbook.

A late encounter between the two regimes occurred when the Rail Administration started the process of revising the traffic safety rules in January 2000 (Blakstad, 2006; Blakstad et al., 2010). In accordance with the new risk-based safety management regime, the intention was to apply a top–down risk-based approach to rule development. The project group tried to apply this top–down risk-based approach, but they did not find it viable. The project group did not fully trust that the proposed process would assure an adequate level of traffic safety. They therefore turned to a process that has been termed "reverse invention" of safety rules (Blakstad, 2006; Blakstad et al., 2010). They used railway knowledge and existing prescriptive rules as the main basis for developing a modified set of prescriptive rules. They used risk analyses in an iterative manner to elaborate issues of concern, to check the quality of evolving rules, and to reveal potential dangers created by changes in the rules. Although the project group wanted to be loyal to the new safety management regime, they found it necessary to modify the approach suggested by the new regime radically in order to adapt it to the specific requirements and constraints associated with development of traffic safety rules for railways.

4.4. Restructuring of the sector and standardization of safety management

Since the restructuring of the sector was intended to make room for external operators on the Norwegian railways, interoperability and compliance with European standards is now a dominating issue. These interoperability standards concern both technical operability and also the safety management systems of operators. Naturally, the standards are less adapted to the specifics of the Norwegian railroad network, as they are developed to be employed across the heterogeneous European railway network. As such, international standards are an intrinsic part and motivation of the new regime.

In the new regime, the operators are required to have a functional Safety Management System. The authorities mainly check that systems are in place. Some smaller operators have to rely on external consultants for the development of governing systems. This caused some concern with the authorities we interviewed as some operators did not have the required competence "in house" but in the form of contractual relationships. Consequently, the contracts themselves, and whether the operator has sufficient control in the principal-agent relationship was a topic in their certification and inspection work.

4.5. Knowledge, power, trends and intermediaries in the Norwegian railway sector

Modern safety management principles did not reach the Norwegian railways in the form of discrete pieces of information that could be added to existing body of knowledge. What we have observed is rather a series of fierce confrontations between two knowledge regimes. The course of the confrontations and their outcomes were influenced by environmental contingencies such as new legislation, deregulation, and internationalization of the railway sector, organizational changes in the NSB, the establishment of a new inspectorate, and the Åsta accident. The new knowledge regime was represented by a series of intermediaries such as the Director of HES, the Railway Authority, research institutes, hired consultants, new safety staff at the Rail Administration, and the public commission that investigated the Åsta accident. The system-specific and local knowledge base associated with the old regime was a precondition for successfully adopting the new regime. However, this knowledge lost visibility and status, because it was peripheral to the domain of safety discourse defined by the new regime. At the same time, the main spokesman of the old regime lost formal authority as traffic safety was subordinated to the more generic HSE discipline. This loss of authority may have been a contributing factor with regard to the Åsta accident. The head of the traffic safety office warned about the lack of automatic train control at the Røros line in two meetings with Rail Administration senior management in 1995 and in two memos directed at the Rail Administration senior managers in 1996 and 1997 (NOU, 2000: 30 p. 153). An automatic train control systems is designed to stop a train if the driver fails to apply the brakes in front of a signal at danger, and it is possible that this would have prevented the collision at Åsta (NOU, 2000: 30 p. 150). The Rail Administration senior management did not react to these warnings. According to the public investigation report, the managing director of NSB could not remember having received the memo issued in 1996 by the head of the traffic safety office concerning the safety problems on the Røros line. The managing director also claimed that nobody in the organisation had said that installation of an automatic train control systems on this line could not be postponed. He further claimed that he, like many others, had been living in the belief that it was safe to drive on the Røros line (NOU, 2000: 30 p. 153). It is conceivable that the head of safety might have been more successful in drawing senior management's attention to this problem if he had a position of authority similar to that before the reorganization in 1993. The marginalization of the practitioners' knowledge may also imply a marginalization of their safety concerns.

5. Maritime standards, intermediaries and disempowerment

The previous section's historical discussion of the railway sector illustrates a transition between different regimes of safety management. The new regime implied a more generic and system-oriented view on safety, linked to international standards. This regime contrasted with the rule-based system that had been closely linked to operational experience, specific to Norwegian railways.

This section's discussion of the maritime sector presents a snapshot of the same trends in which local operational knowledge is rendered less relevant as it is faced with safety regimes based on generic models of safety and international standards. For many of our informants, these are stories about disempowerment. Based on interviews, we will now discuss these developments and the role of the regulators and consultants as intermediaries.

5.1. Basics about the maritime safety regulation

The Norwegian Maritime Authority was organized in 1903 to control and supervise the safe operation of ships and seafarers in Norwegian waters (Norwegian Maritime Authority, 2012). A basis for their work is their national regulations, which also includes ratified rules from, for instance, the European Union and the Interna-

tional Maritime Organization (IMO). The international regulations are established by consensus, which in most cases means that it takes time to implement changes. For instance, the International standard for the safe management and operation of ships and for pollution prevention (the ISM code) was first agreed upon by IMO in 1994, and in 2002 almost all international shipping was required to comply.

According to the ISM code, all ships are required to have a working safety management system. After the company has developed their safety management system for the organization and each vessel, they have to be controlled, certified, and thereafter audited every 2.5–3 years. The Norwegian Ministry of Trade and Industry (owner of the Maritime Authority) has delegated supervision authority, including ISM certification and revisions of shipping companies, to five consultant companies (also called recognized organizations). The Norwegian authorities have ratified the recognized organizations' procedures (NOU, 2008: 8). The recognized organizations are also operating as consultants developing safety management systems for shipping companies.

5.2. Disempowerment at the sharp end faced with complex regulation

More than the railways, shipping is an international industry. Most of the Norwegian-owned vessels in international shipping are flagged out, but in coastal shipping many vessels remain under Norwegian flag. Still, much regulation comes from international bodies, and national rules seldom deviate from these international regulations. In the interviews, our informants told how vessels owned by family businesses tried to make sense of and comply with a vast body of rules and regulations. In this work, most of them relied on help from consultants who possessed more knowledge of the system.

> *We had as starting point, me and the consultant, that we'd make [our safety management system] as small and clear as possible. I think it was 43 pages. And now it's about … let's look in it … We've one operational guide and one quality plan … we can't get an overview over how many pages it is. (Master, passenger vessel)*

> *No, we can't do anything. The only thing we can do is trying to find the easiest way to meet the demands. […] It is not possible to argue against safety. And they can refer to all kinds of [regulations]. (Employee, maritime interest organization)*

Since the regulation leaves limited room for local variation and the heterogeneity of the fleet, much of it is seen as unnecessary, and even as a threat to safety, due to increased workload and changed focus to administrative work.

> *If you're to have so much reporting and governmental surveillance and there's no sensible reason for it… it becomes a risk. It had actually been fronted by both the Maritime Officer's Association and the Federation of Norwegian Coastal Shipping on [a conference] that the safety demands are a threat to safety. (Management, maritime interest organization)*

The safety systems are built around accountability and the principle that safety is documented by following up a standardized set of items. This results in a heavy burden of reporting.

> *And often we feel that the new requirements… are pure, unadulterated abuse some times. And has little to do with carrying out safety work. Like the ISM and these things. It's a set of rules and it's a rule of red tape. This is one of the things we've worked with the Maritime Authority about; limiting all the demands from the authorities that concern reporting. That really works against safety in my opinion. (Management, maritime interest organization)*

5.3. Standards and reporting

> *You can't expect the same of sand-boats as with an [oil.-tanker]. But they are subject to the same regulations. So [the inspector] at a sand-boat should have some sense of reality … (Employee, maritime interest organization)*

Safety management is to an increasing extent built around international standards, and by systems based on accountability and transparency. The national supervisory body typically makes minimal changes while adapting European rules to the Norwegian context. The rules, which are international and made to be applicable in several different settings, are more complex, more abstract, and less locally relevant than what is optimal for each setting. Deregulation and international competition is a key driver of this trend towards standardization. Common rules level the playing field. They must also be supervised and regulated in a transparent and accountable manner, so as to avoid preferential treatment for local operators. The quotations above illustrate the local implementation issues for systems that are standardized across contexts and nations. The process of standardization can be problematic and painful, but this should not be seen as an argument against standards as such. Standards are attempts to convey good safety knowledge in a fair and transparent manner, without hampering competition. In the case of national regulation, for example, safety demands can be used politically to exclude transporters from other countries. Standards are political.[4] When discussing IMO's workour informants stated belief in their good intentions when creating international safety regulations, but felt that these intentions often disappeared when they were translated into the standards.

What we observed in the maritime shipping industry was that the ISM code and the demands for a systematic and generic approach to safety meant that many companies needed help with translating, implementing, and satisfying the system.

5.4. Intermediaries – safety consultants and authorities

Several of our informants discussed how the companies were becoming increasingly dependent on the consultants to translate regulations to practice and help them develop a management system and report according to the accountability-based systems. When the ISM code first was implemented about ten years ago, the maritime organizations did not have competence in building the safety management systems that the code demanded. As the international standards are abstract, detailed, and complicated, and the work involved in translating these to practice in the individual vessels is comprehensive, external safety specialists were needed as brokers and translators of the standardized and accountability based regimes.

It's amazingly many working in safety. How many lectures we've been to and listened to about how the world isn't able to survive if we don't have all these safety companies. It surely has become an industry. (Management, maritime interest organization).

> *[The consultant company] have never earned as well as after they got the ISM. I know many competent people in [this consultant company], but after ISM everything is going on paper to be documentable. I have written deviations and commented the formulations on the deviations, and they are sent back and forward. It's silly. (Master, cargo vessel)*

The importance of the consultants and their knowledge has grown, and there is a growing industry helping the shipping companies to comply with regulations. Some also see it as a problem that the Maritime Authority has delegated the ISM certification

[4] See also Busch (2011) and Bowker and Star (1999).

to third-party consultant companies. The following quotation may illustrate how the international standards give leverage to the consultants, as important interpreters, while the Maritime Authority is perceived as powerless when faced with international regulatory initiatives. This informant recounts his observation of two lectures at a conference to illustrate his point:

> *. . . the IMO-representatives stressed that here the national authorities had to have a firm hand on [the safety systems] and not leave it to every company to develop. They said that very clearly. The Maritime Authority people were more or less sitting there with their heads bowed. And next speaker on the program, that was the guy from [a consultant firm] who was talking about now there'll be two days of extra inspection aboard.[. . .]The [authorities] let the recognized organizations develop after their own needs. And then we're back to the industry we talked about again. (Management, maritime interest organization)*

It is quite evident that the knowledge about safety management, and the standards and accountability regimes in which much of it is inscribed, is subject to power struggles. To disentangle what is pure knowledge and what is pure politics or power from these struggles is not possible, and consequently the observations from our informants are more indications that a struggle is going on than an unbiased description of the nature of it. An interesting aspect of the role of the consultants as intermediaries is the principal-agent dilemma they pose. The consultants are hired to help the companies comply with regulation and, hopefully, to help them improve safety. One could assume, however, that they also have an interest in being relevant and useful so as to be hired again. The shipping companies see an industry developing. We do not question the usefulness and good intentions of this industry, but as in all principal-agent relationships their interests do not fully overlap with that of their clients.

The misalignment of over-complex systems to the realities in Norwegian coastal transport and the ambiguous role of consultants was the self-proclaimed rationale of a unit in the maritime interest organization we visited. The unit was established to help their member companies in the work of transforming abstract standardized regulation and rules into workable internal procedures and documentation. Their main interest was in making the systems simple and usable, and not necessarily primarily to satisfy "every comma in the rulebook."

> *Something that's a concern is that there are made so many new regulations all the time. There isn't enough time to follow the jungle of regulations. Large challenges. The ISM code's very simple in itself if you get to know it. [..] Knowledge about ISM code can be boiled down to a very simple standard. (Representative, maritime interest organization)*

The organization sees their members losing power when faced with specialists mastering complex regulation. The unit can be seen as a response to this development challenging the perceived model monopoly of the specialists, trying to stick to the simplest possible implementation of the ISM code.

Though the difference between sectors is distinct, we see here as in the railway case that generic safety management principles, international standards, and accountability regimes leaving paper trails emerge as distinct entities that challenge the relevance of experiential knowledge specific to unique sites or operations.

6. Discussion

In Sections 4 and 5, we discussed a shift in towards a more generic and theoretical view of safety and accompanying shifts in power relations in railway and maritime organizations. The local experience-based knowledge seems to be rendered irrelevant in the more theoretical and generic discourse of safety contained in standardized, accountability-based systems. We will now discuss the consequences of this shift in safety knowledge and power, how the new systems and standards might result in safer operations or repress the original safety knowledge – and why these findings should be of concern to safety scientists.

6.1. Marginalization of system-specific and local safety knowledge

Throughout the empirical section, we have seen changes that cause proponents of safety knowledge embedded in operational procedures and situated practices to lose impact in decision processes. More "organic" ways of working with safety are increasingly been displaced by safety as a discipline and topic external to the specifics of everyday operations. System-specific and local safety knowledge has traditionally been hegemonic in both railway and maritime transportation. Good seamanship and the experience-based rules in the railroad systems is knowledge that is specific to the sector, to specific systems, and sometimes also to more local contexts in which individuals work. Several mechanisms may have contributed to a loss of this hegemony, or marginalization of traditional knowledge, when new safety management requirements were introduced in the two sectors. The new safety management requirements were based on generic management principles rather than system-specific safety strategies. In the railway case, a new safety discourse highlighted generic safety management activities, whereas the system-specific activities and knowledge were subordinated or not mentioned at all, as illustrated in Section 3.2. In the maritime transportation case, the focus on documentation of procedures made tacit system-specific or local knowledge irrelevant – unless it could be codified in the form of new procedures. As a consequence, more system- or context-specific knowledge forms were marginalized or assimilated to the new procedural style.

Regulatory and management attention was directed at the development and implementation of the new, safety management systems, and to the follow-up activities prescribed by these systems. System-specific and local knowledge may also be marginalized in an organization if its spokespersons lose authority and influence. In the railway case, the main spokesman of the system-specific safety knowledge, the head of the traffic safety department, lost status and direct access to the managing director when the Director of HES was appointed in 1993.

The marginalization discussed here does not necessarily imply that the system-specific knowledge went out of use. This knowledge was still necessary to operate trains and ships in a safe manner. Rather, marginalization implied that the system-specific knowledge lost status, attention and impact in the organizations. Experiential knowledge accumulated over decades, both in its explicit and in its implicit forms, was subordinated to more generalized models and systems of safety management.

6.2. Compartmentalization of safety and disempowerment of the practitioners

New actors entered the scene in both cases. In the railway case, we noted the appearance of the Director of HES (and his staff), the new regulatory authority, consultants engaged to develop a safety management system for the Railway Administration, new safety staff, and the members of the public commission that investigated in Åsta accident. In the maritime sector, the last decade's implementation of the ISM standard has generated a market for consultant companies and HSE officers, developing and revising safety management systems for the shipping companies and vessels. These new actors were in most cases outsiders to the communities

of practice that operated railways and ships. As a consequence, safety became a separate discipline, more detached from the practice field.[5]

The consultants and safety professionals, we have argued, possess not only knowledge of the systems through which work is governed, but also model power. In our data, there are repeated stories of how practitioners experienced disempowerment when confronted with standardized safety management systems and their representatives. Their arguments and concerns were marginalized in the new, generic safety discourse. In some cases, they lost formal authority or access to senior management. In discussions about safety, they often became the weak part in a situation characterized by a model monopoly. Moreover, they were not in a position to break out of the model monopoly by redefining the domain of discourse, because the models were introduced in the form of mandatory regulations or standards. This weakness is doubly important given the fact that the safety specialists are often agents in relationships characterized by principal-agent dilemmas: The agents hired to help a company with the safety systems do not necessarily have the exact same interests as their principal. We have suggested that at least in some cases, it can be in the interest of the hired safety specialists (the agent) to work with more standardized systems and systems that require less local adaptation.

6.3. Standardization and professionalization of the safety field

In both our empirical cases we have noted an increased focus on accountability. Safety work should leave a "paper trail" for management and authorities to inspect and compare with other sites. What we have discussed is a development where risk and safety management becomes a subset of the management systems in general (Power, 2007). A prominent example of this is the internal control regime, which is built on standardized, transparent, and auditable information flows. Working and reporting according to standards necessitates translations of one's specific context to the standardized categories when reporting, and when working according to standards, translating, and situating the requirements to one's own specific context (Almklov and Antonsen, 2010). This development is best illustrated by our discussion of ISM regulation to small cargo vessels, and is connected to the compartmentalization of safety work (see Section 6.2). Safety management governed by the ISM systems and generalized self-regulation of HSE in the railway sector is less connected to the situated practices in which work is performed. All representations of work need to be translated when put into action. They can be treated as resources for action, rather than recipes to be followed mindlessly. As the example with the maritime interest organization suggests, skilful navigation within the new regimes is possible. As such, a crucial topic for safety research is to understand the translation processes between rules and regulations and practice, beyond compliance and non-compliance, including the role of intermediaries.

6.4. Implications for safety

To be relevant and effective, a safety system must be anchored in, and relevant for, local practice. The changing power relations associated with the marginalization of local and system-specific knowledge may affect the ability for practitioners to convey their concerns and observations and for the relevance and utility of the system.[6] Important experience may be lost as it must be filtered through a standardizing discourse and the models of safety professionals.

It is outside the scope of the present study to assess the combined effects of new safety management systems on safety. We acknowledge that dedicated brokers in many cases are able to make standardized systems useful in practice (as shown by for instance Kongsvik et al., in press). Daniellou et al. (2011) emphasize the managers' responsibility in translating practical knowledge to the safety management systems, and vice versa. The observations here are still warnings of a possible downside of these developments. We need to consider whether the reliance on standards, the accountability explosion, and the compartmentalization of safety management may weaken typical resilience-generating factors of organizations. A central idea in Resilience Engineering, for example, is that variability in how work is performed may also contribute to improved safety (Hollnagel et al., 2006; see also Rasmussen, 1997 and Roe and Schulman, 2008). Generic safety systems geared on standards and control are likely to reduce not only harmful deviations from procedures, but also the adaptations that might make work more resilient. Rigidly structured work, void of joyful exploration (Rasmussen, 1997: 193) and creative adaptations may also over time lead to de-skilling at the sharp end. Also, the weight put on transparency and paper trails may lead to focus on avoiding error and "managing to audit" (Hood, 2007: 207), which may hamper typical resilience-generating creativity. If one's every action must be by the book, one may face strong incentives to manipulate information flows to avoid blame (Hood, 2007; see also Dekker, 2007). One can experience that compliance is only on paper, decoupled from practice.

6.5. The role and responsibilities of safety science and safety scientists

Safety science is a science with ambitions of being useful and applicable. Consequently safety scientists need to take into account power issues related to the knowledge they produce and promote. Safety management systems and standards are informed by safety research, but they are also shaped by the dominating management discourses (Power, 2007). If the dominating mode of governance is checklists and paper trails, our research is likely to end up as another item on the list or another report required from the sharp end. We have noted a distinct displacement of discursive hegemony towards a more systemic conception of safety in safety management. We have also noted a corresponding displacement of power from the spokespersons of local and system-specific safety knowledge to the advocates of generic safety management principles. We need to consider to what extent and how safety science contributes to these displacements of hegemony and power.

The direct implication of safety scientists in developing and implementing new standards and regulations was rather limited in the cases presented in this paper. Research institutions have assisted the Norwegian State Railways and the National Rail Administration in their efforts to comply with new safety regulations, but the volume of this assistance is small compared to that provided by consulting firms. A few persons have migrated between research institutions, consulting firms, and the organizations that have been subjected to the new regulations. These persons may in some cases have acted as mediators between generic and system-specific safety knowledge. However, we are not aware that safety scientists have played any major part in the development of the regulations and standards referred to or the decisions to implement those standards.

Safety scientists may have played a more important role through the contents and directions of their research and the tacit or explicit assumptions on which this research is based. Scientists tend to seek generic explanations and theories that are applicable across cases. Haavik (this issue) suggests that theories such as High

[5] See Amalberti (2013) for more about the emergence and compartmentalization of the safety field and consequences for industries and regulators.

[6] Almklov & Antonsen (forthcoming) suggest that important aspects of continuous operational work fail to be captured in standardized documentation systems.

Reliability Organizations, Normal Accident Theory and Resilience Engineering are all fundamentally relational in their origins, and that they are all frameworks initially conceived "bottom up" from detailed studies of situated sociotechnical relations and practice. Later on, as they are included in the theoretical body of safety science, these insights are typically reframed as generic principles and the importance of situated studies is lost. The tendency within the scientific discipline to generalize and the systems through which safety is managed in the industries challenge more local understandings, situated in specific sociotechnical systems with specific contexts. Many frameworks and theories also aim to understand the context specific variability and practices. Still, there is reason to ask whether even the most context sensitive observations and theories are able to inspire safety management that is not geared on accountability and standardization. Given the by now well founded assumption that experience-based creativity and situational adaptation is important in some situations, it is a critical challenge for safety science as an applied discipline to be able to propose organizing models and systems that support these abilities.

The search for broad generalizations in safety science has also led to a relative scarcity of theory and research addressing differences between systems and sectors and the implications of these differences for safety management. One theorist that makes such differentiations is Perrow (1984), who proposes that tightly coupled technologies require centralized control structures whereas technologies with complex interactions require decentralized control structures. Another example is Rasmussen's (1997) proposal that different risk control strategies are required for domains with, respectively, (1) frequent, small-scale accidents, (2) major accidents, and (3) large-scale accidents (e.g., nuclear power plant melt-down). Safety science could make the value of system-specific and local safety knowledge more salient by providing more insight into the need for differentiation of strategies and means for risk control.

Another aspect of the safety scientists' role in the knowledge shift is the widespread adoption of cybernetic thinking, with its focus on control, deviations and feedback. Such thinking tends to resonate with the focus on accountability and traceability observed in the present study, because control loops are often relatively easy to "translate" into administrative controls. We do not deny the value of cybernetic thinking in safety science, but safety scientists need to be aware of the limitations of very simple cybernetic models. These models rarely differentiate between systems with different properties, and they may thus be used to justify generalized and undifferentiated safety management strategies. Moreover, very simple cybernetic models are rarely falsifiable. A model prescribing that companies should discover all significant hazards by means of feedback systems and feed-forward analysis, and then select and implement effective risk reduction measures against these hazards will be "confirmed" by any accident, since the occurrence of an accident logically implies that some hazard has been undetected or that effective risk reduction measures have not been implemented. Cybernetic thinking may, on the other hand, be used to differentiate between the control problems associated with different systems as illustrated by the examples of Perrow (1984) and Rasmussen, 1997 mentioned above.

Some of our most cherished academic virtues, such as precise definitions, consistency, and exclusion of irrelevant facts and arguments may at times promote a model monopoly. The most important symptom of this circumstance is perhaps the apparent absence of tensions and the apparent ease with which contradictory evidence can be defined as irrelevant or reinterpreted to be in harmony with our model. Such apparent absence of tensions is not a very strong signal. With reference to Bråten's theory of model monopoly, safety scientists may consider (1) whether their research tends to define a domain of discourse that excludes the voices of practitioners, (2) whether their research invites practitioners to contribute complementary or competing perspectives of their own, (3) to what extent the knowledge they produce reflect the premises and interests of potentially disadvantaged actors, (4) whether their research can challenge dominant knowledge sources that have established a model monopoly, and (5) whether their own research efforts have been captured by a model monopoly with a monolithic perspective. Challenging model monopolies may enhance the diversity of organizational sense-making with regard to risks and thus contribute to the "requisite imagination" (Westrum, 1993) or "conceptual slack" (Schulman, 1993) of the organization. It may also counteract tendencies to ignore warnings that are at odds with the dominant beliefs and norms in the organization (Turner and Pidgeon, 1997).

The development of standards and regulations involves generalization of safety knowledge from operations through companies, interest organizations, scientists, regulators, politicians, and others (as shown by Rasmussen 1997), to the international organizations and in the conventions and standards. After it is standardized and ratified, the knowledge will again have to be translated and adapted to the local context. This translation work will be done by the same regulators, companies, operative personnel, and possibly safety scientists, but also by brokers such as the model-strong consultants with strong influence on how the companies will have to implement the standards. If we consider the globalization and standardization of safety knowledge inevitable in the current political setting, then safety scientists need to consider what roles, if any, they want to seek in the development of standards and regulations and in their implementation. In some cases, safety scientists may be sufficiently familiar with the local context to make the standardization, adaptation, and implementation easier for the other actors. This local knowledge is not always manifested in the generalized models and theories, and it may be ignored and get lost if we leave it to the rest of the actors to generalize, standardize, regulate, and again adapt this knowledge into safe operations.

Argyris and Schön (1996: 35–43) propose a view of practitioners as inquirers in their own right. According to this view, practitioners want to learn about causal connections between organizational actions and outcomes in order to understand how organizations work and how they may be changed. They also seek to make sense of surprises and they often reflect on organizational practice. Practitioners even carry out experiments to gain new knowledge about their organization or sociotechnical system. There are, however, significant differences between the inquiry of practitioners and academic research as depicted by the conventional norms of rigorous scientific inquiry. Argyris and Schön (1983) propose "action research" as an approach to better integrate the knowledge of researchers and practitioners and to reduce the asymmetries of power produced when researchers provide practitioners with knowledge they can choose to adopt or not. They suggest that the researchers should "join with practitioners to help discover the hidden rationalities that are often built into everyday organizational practice, the productive forms of pattern causality of which practitioners themselves are often unaware" (p. 43). The researchers should help practitioners extend and enhance the inquiry they already know how to carry out, for instance by helping them discover how they get stuck and what dilemmas underlie their getting stuck, or how the same patterns of action that lead to success may also, on occasion, lead to failure. While action research may alleviate some of the power issues we address in this paper, it is also an approach that will tend to be local in nature, and only to a limited degree be able to challenge the surrounding framework of regulation, systems of accountability and standards.

6.6. Limitations and generalizability of the results

The empirical story we have told here is one about power and disempowerment of the practice field in the wake of sweeping trends of professionalization of safety management. We have described some developments in two Norwegian transport sectors that seem to be manifestations of broader societal and technological trends. The results cannot be generalized on a statistical basis. Rather, they invite a search for confirming cases as well as "counter cases" that may moderate our analysis. Moreover, as suggested by the analysis model (Fig. 1), different effects may occur under different contingencies such as other societal trends or other intermediaries. However, the theoretical arguments are in principle applicable to other similar settings where intermediaries translate the results from safety science into standards and regulations and subsequently translate and adapt such knowledge to the local context. The phenomena of discursive power, model monopoly, and information asymmetry in principal-agent relationships could manifest themselves in a broad variety of circumstances. As a consequence, knowledge and power will remain interrelated.

7. Conclusion

The empirical examples presented in this paper show that the results of safety science do not necessarily have the form of neutral information when they reach the practitioners. In both cases, results from safety science were introduced as part of new safety management regimes. These regimes comprised new discourses on safety which challenged basic assumptions of the old regimes and made the more local or system-specific knowledge associated with the old regimes peripheral, irrelevant or invalid. By redefining the domain of discourse, the new regimes created model monopolies where the representatives of the old regime emerged as model-weak actors. In the railway case, we also observed that main spokespersons of the old regime lost formal authority and positions of influence in their organization. In the maritime case, we observed that ship-owners who engaged consulting firms to develop safety management systems in accordance with the regulatory requirements experienced principal-agent problems because the ship-owners possessed limited information about the requirements to these systems. The new regimes may have contributed to significant improvements in risk management practices, but they may also have made the organisations involved less attentive to the safety concerns of representatives of the old regimes.

The disempowerment experienced by many practitioners and the marginalization of their safety knowledge is not a simple and direct effect of the knowledge produced by the safety science community. Rather, these effects are created in a constellation of (1) environmental contingencies such as new regulations and international standards and (2) intermediaries between safety scientists and practitioners, such as regulatory authorities and consultants. These constellations are influenced by more general societal trends, such as professionalization of the safety field and current demands for standardization and self-regulation through accountability-based systems.

The position of safety scientists in such processes is ambiguous. The search for broad generalizations and the widespread adoption of cybernetic thinking in safety science tends to resonate with trends towards standardization and bureaucratic control. The knowledge produced by safety scientists may be used in ways that the safety scientists did not intend and in settings they could not foresee. Safety scientists may, however, also be in a position to help practitioners challenge emerging model monopolies and thus enhance the diversity of sense-making with regard to risks. Safety scientists should therefore reflect on how the results they publish may interact with existing local and system-specific safety knowledge.

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Fish first
Sharp end decision-making at Norwegian fish farms

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ABSTRACT

Aquaculture is the most accident exposed industry in Norway, after fisheries.

Interviews and observations of 55 persons in twelve aquaculture companies indicate that management rely on operating workers to make all safety-decisions in the operations, for both their biological product and themselves. Still, there is no published research about aquaculture decision-making.

Given the reliance in decisions on the net cages, and the industry's accident rate, it seems important to investigate how and why safety-related decisions are made. This paper explores criteria and constraints for decision-making in sharp end operations at fish farms. Two common situations with risk of loss are described and analyzed according to relevant research:

- Net cage damage discovered during feeding. How to manage both planned tasks and necessary modifications?
- The well boat crew must get the fish to the harvesting plant, but the weather is bad. How to handle tasks, time pressure and unstable conditions?

The findings show that decision-makers often neglect personnel safety on behalf of product safety. Even though criteria and constraints largely coincide with theory and are similar in the two example operations, the personnel safety outcome is different. In *daily* operations there is major risk for the operating personnel, while in the rare well boat operations the conditions best for the fish also prevent personnel harm.

When dealing with a biological production process ordinary safety measures are inadequate – because when activities need to be done at the exact right time for the product to be profitable, personnel safety comes second.

1. Introduction

Aquaculture is one of the most accident exposed industries in Norway. Only fisheries have more casualties and injuries per man-labor year; with offshore industry and agriculture ranked third and fourth (Aasjord and Geving, 2009). In 2000–2008 the Norwegian authorities registered 702 injuries among the 5000 employees in the fish farm industry (The Norwegian Labour Inspection Authority, 2010). In the United Kingdom aquaculture is a small employer so there is a substantial margin of error, but no sector have fatal or major injury rates as high as aquaculture (Health and Safety Executive, 2011). In most fishfarming countries statistics show that aquaculture is a dangerous industry to work for. Operations are similar in most sea based fish farms: They breed shellfish or fish – in Norway mainly salmon – by keeping and feeding the fish in net cages along the coast. Well boats transport fish from the land based hatchery to the net cages, and after about 2.5 years in the sea the fish can be delivered to the harvesting plant. Most accidents are caused by falls, pinches, perforating or other impacts during day-to-day operations such as feeding and net cage maintenance. There are also great possibilities for injuries in severe operations of transporting or lice treatment.

The high accident rate was why safety perception and precaution at Norwegian fish farms were investigated in the project *Aquaculture and intelligent transport systems* in 2008. There we identified organizational conditions of importance to prevent accidents, and found that due to changes in the aquaculture industry, more systematic safety measures are required (Fenstad et al., 2009). We saw that the management (the organizations 'blunt end') rely on operating co-workers (the organizations 'sharp end') to make all practical safety-decisions in the operations. The organizations' safety arrangements are usually restricted to effectuating procedures decreed by law. Operating employees' main responsibility

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is to feed, care for and make sure the fish get in the best conditions to the harvesting plant. The operating fishfarmers are made responsible to consider the hazards, perform the tasks, and maintain the operational safety – even in operations involving ample risk for both product and personnel. The fishfarmers stand out as self-governed craftsmen and tell that most accidents are due to 'idiot decisions', where the actor works too fast and ignore hazards in day to day operations.

It is important to further investigate the operational decision-setting to understand why it appears to be a great number of 'idiot decisions' in the aquaculture industry. In this paper I therefore go deeper into the data by studying in detail two common empirical situations associated with hazard. One happens during a daily operation – feeding – and the other during a less frequent operation – delivery to well boat. *The objective is to identify criteria and constraints for decision-making in sharp end operations at fish farms, compare it to existing decision-making theory and discuss the safety relevance*.

After two sections about methodology and theoretical overview, I will describe the two example situations and then discuss it according to decision-making theory and safety. The analysis reveals that criteria and constraints in these fish farm operations largely coincide with theory, and that the fishfarmers do all they can to avoid injured fish or escape. Starvation or escape of the fish can lead to economical and environmental catastrophes; lost farmed salmon swimming around in the sea cannot be sold on a demanding market but instead spread diseases or eradicate wild salmon and other important species. Therefore fishfarmers must prioritize the biological production process and will increase *personnel* safety only if it is best for the fish. In the daily operations this constitutes a major risk for the fishfarmers involved, while in well boat operations the conditions best for the fish can also prevent personnel harm.

1.1. Clarifications

Decision-making is in this article seen as an individual or collective activity, over shorter or longer time, more or less intentional, constrained and shaped by both context and individual qualities (Rosness, 2009, pp. 1–2). To become aware of which decisions have lead to action and to understand what happened, we search for the moment where the actor could choose to act out other alternatives, and try to comprehend the situation as a whole.

> *We may identify a point in time where a decision 'must' have been made, because we can think of alternative choices that the actor could have made. (...) I see no way we can go beyond sense-making and reconstruction and observe 'pure decision-making' or 'decision-making as such'. What we should aim for is rather to 'make better sense' of decision-making activities by seeking constructs which pinpoint aspects of decision-making activities that otherwise tend to be missed or distorted* (Rosness, 2009, pp. 1–2)

In this article I will describe two situations, and look for decision-criteria and constraints. It is difficult to part the decision from the decision-making-process, and it is important to take into account the social context in the work process (March, 1994; Rasmussen, 1997; Rosness, 2009).[1]

Decisions involving risk of accidental loss, are decisions where there is a possibility that the decision-making lead to actions or events with consequences that negatively affect something people values (Rosness, 2009), for example personnel, product or environment. This is related to the term safety, meaning that operations are carried out as intended, without accidents or harm (Dekker, 2002). Whether an operation is safe or not depends to a large degree on decisions made, before and under the operations. Operational personnel's decisions are crucial, and the decisions are made according to their internalized values.

2. Materials and methods

About 4000–5000 persons work in the aquaculture industry in Norway, in around 1500 fish farms (Statistics Norway, 2011), 95 well boats and a number of related companies.

This paper contains selected results from a qualitative study for the project *Aquaculture and intelligent transport systems* in 2008, where we searched for safety perceptions and precautions in transport operations on fish farms (Fenstad et al., 2009). The material consists of observation and interviews of 55 persons on nine salmon farms, two well boats and a diving company. This sample is representative for two different regions in Norway, and might constitute a cross section of the national fish farming industry. All informants had chores in the operations at the fish farms, and were a part of the organization's sharp end. For totally 9 days the researchers participated in meetings and operations with the informants. Thirty five of the observed persons were also interviewed, in 19 semi structured interviews of one and a half hour about the work and decision-making in the operations on the net cage. Notes were made for every interview, and half of the interviews were recorded.

The data collection led to much information and many stories about decision-making, especially in the two operations described later in this article. These two case operations were selected because they are situations with risk of ample accidental loss that every fishfarmer experience commonly, even though details and decisions vary. I have observed both operations, and investigated such situations with the informants in interviews. The cases are also discussed with other aquaculture personnel in gatherings or data collections in our portfolio of aquaculture research projects.

All the data form the basis for this paper, but only the recorded interviews are source for the explicit quotations in the paper's result part.

3. Models about decision-making in the sharp end

To analyze empirical decision-making in the fish farm operations, I employ tools from prior research: Rosness' (2009) overview of theory on decision-making involving risk of accidental loss, Klein's (1993) recognition-based decision-making, and Rasmussen's (1986, 1997) skill and rule based decision-making. All are based on multi-industrial research, and stand out as general for decision-making in various operations and occupations, even though aquaculture operations or operations with biological production processes has not been studied before.

Rosness have characterized five decision settings based on proximity to the hazard and level of authority: Operations; business management; administrative and technical functions; political arenas; and crisis handling (see Fig. 1).[2]

The *operation* setting consists for instance of the fish farmers and seamen that execute the operations in this study. They have certain constraints, criteria and modes when they make decisions in their job, different from for instance when their CEO makes decisions. Table 1 shows hypotheses concerning constraints on decision-makers, decision criteria and decision modes in the operational decision setting. Information about the constraints and their impact on deci-

[1] I do not aim to empirically part the decision from the decision-making. I neither aim to identify decision aids, although it would be positive if the analysis could contribute to increased safety for the fish farm personnel.

[2] All decision settings are connected, but the interactions and other settings must be discussed in another paper.

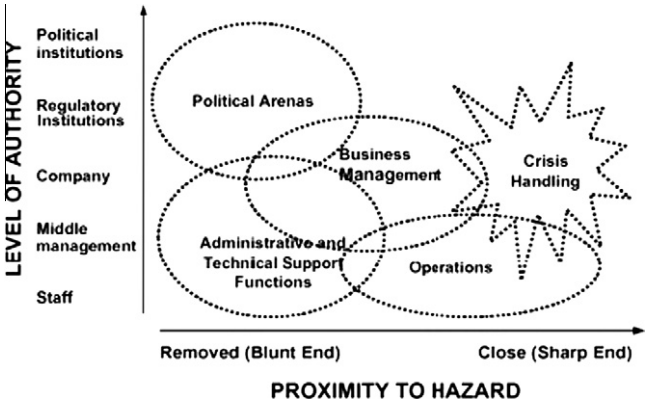

Fig. 1. Typology of decision settings (Rosness, 2009, p. 808).

sion-making may help understand the decision-process, and especially why seemingly irrational or reckless decisions are made.

The suggested decision constraints in the operations setting are *workload* and *limited situation awareness*, while decision criteria are *smooth and efficient operations* and *acceptable workload*. Both decision modes mentioned point out that experienced employees in operations will not approach decisions analytically or based on comparison of strength and weaknesses (Klein, 1993, p. 143). Instead of judging one option to be superior to others, workers will use situation assessment and mental simulation: 'recognitional decision-making', as Klein (1993) puts it. This implies that experienced staff can find a good decision fast in an informal and satisfying way, rather than generate and analyze many options (as less experienced decision-makers would). Recognitional decision-making will usually be considered the best method by experienced decision makers when time pressure is great and conditions instable (Klein, 1993, p. 146). Examples from firefighters set this in an empirical perspective:

> *Once the fireground commanders knew it was "that" type of case, they usually also knew the typical way of reacting to it. They would use available time to evaluate an option's feasibility before implementing it. They would imagine how the option was going to be implemented, to discover if anything important might go wrong. If problems were foreseen, then the option might be modified or rejected altogether, and another highly typical reaction explored.*(Klein, 1993, p. 140)

The recognitional decision-mode corresponds with Rasmussen's skill- and rule-based decision-mode (Rasmussen, 1986, pp. 100–103; Rasmussen, 1997) in most ways. Rasmussen stresses that

> *(. . .) actors are immersed in the work context for extended periods; they know by heart the normal flow of activities and the action alternatives available. During familiar situations, therefore, knowledge-based, analytical reasoning and planning is replaced by a simple skill- and rule-based choice among familiar action alternatives, that is, on practice and know-how. When, in such situations, operational decisions are taken, they will not be based on rational situation analysis, only on the information which, in the running context, is necessary to distinguish among the perceived alternatives for action* (Rasmussen, 1997, pp. 187–188)

The two decision modes in Table 1 can also be supported by Rasmussen's (1997) perspectives on decision-making and performance: Work systems are shaped by objectives and constraints, but many degrees of freedom are left open and have to be closed by the actors. Decisions are made by criteria such as work load, cost effectiveness, risk of failure and skills. In most organizations, employees want to minimize *effort* and management to minimize *costs* (Rasmussen's, 1997). Therefore employees often trade thoroughness for efficiency and do the operation as fast as possible, but "likelihood of failures grow when production pressures do not allow sufficient time – and effort – to develop and maintain the precautions that normally keep failure at bay" (Hollnagel, 2009, p. 3).

4. Two empirical situations

At the fish farms we visited in 2008 operating employees were responsible for the safety and their live product even in operations involving ample risk of accidental loss. Interviews and observation revealed that both 'white collar' and 'blue collar' employees had confidence in the 'blue collar' personnel's operational decisions. So, what are the criteria and constraints for decision-making in sharp end operations at fish farms? Based on the interviews with and observations of the fishfarmers on nine salmon farms, maintenance divers, and seamen on two well boats I will here show examples of decision-making in the most common operations involving risk of ample loss.

4.1. Operation 1: Damage is discovered during feeding. How to manage both planned tasks and necessary modifications?

The worst realistic scenario that can happen to a fish farm is that the fish escapes or dies. Therefore it is important that the fish is healthy, and the net cage flawless at all times. Skipping maintenance is not saving resources. Most fishfarmers are out on the net cage many times a day, to observe fish and equipment and take care of potential problems. Experienced fishfarmers immediately notice if something is wrong. If a feeding machine has loose screws or a net-pole has tilted, it can lead to a hole in the net which can turn into a nightmare. The fishfarmers have to repair all damage as soon as they notice it.

It is common for fishfarmers to discuss experiences and problems with colleagues during the breaks. In some areas they also seek advice from each other by exchanging knowledge and practice through their social networks. Both inexperienced and experienced workers are confident that this exchange of information and solutions enables them to make the right decisions, for instance whether they are going to repair something right away on the net cage or call in experts.

> *It's when people tell what they have learned. You talk to the persons you work with, and they talk to other people. The jungle drum. Things are told and you think: 'I'll have to remember this when I'll do these things.'*

Table 1
Characteristics of the operational decision setting (Rosness, 2009, p. 809).

Decision setting	Dominant constraints	Dominant decision criteria	Representative decision modes
Operations	– Workload	– Smooth and efficient operations	– Skill based and knowledge based action intermittently interrupted by knowledge based problem solving (Rasmussen)
	– Limited situation awareness	– Acceptable workload	– Recognition-primed decision-making (Klein)

Some fishfarmers have a short boat ride from an office raft to the net cages, and take daily trips to the net cage to control that fish and equipment is okay. The fish get fed by an automatic feeding machine (which blows the fodder from the raft through pipes to the fish in the net cages). Other fishfarmers must drive the boat (maybe some miles from the quay) with fodder sacks, and manually load the fodder in machines at the net cage before they can start feeding. They therefore spend hours on the net cages. If the fishfarmers do not come to the net cage, the fish do not get fed. And if it does not eat and gain weight, it is not profitable. Therefore the net cage-routines are carefully planned in the fishfarmers' daily schedule. The farmers jump into the boat and onto the net cage in all types of weather, even when waves or wind are dangerously strong. First priority is the wellbeing of the fish, almost no matter what. They tell that this make them know their fish and net cage, and that this is the key to success:

We've had [. . .] great feeding factors. We're some of the best in the country. [. . .] Because we take care when we're feeding, you know. We watch closely. Instead of starting the machine and leave it on. [. . .] We're only feeding by hand; we aren't doing anything without watching.

We will now take a closer look at a situation that – with variations – is common for the manually feeding fishfarmers, and that the researchers witnessed in 2008: Two experienced fishfarmers arrive on a net cage to start feeding, with a boat full of sacks of fodder. They realize that one of the poles that hold up the net over the fish is contorted. This needs to be fixed immediately, to prevent damage in the net under the water. To repair the pole, one fishfarmer must be lifted close to the pole (with the boat's crane). The operation involves ample risk, because the fishfarmer will be hanging in something that moves up and down and side to side while he tries to fix the pole that moves in different directions. Pinch and perforate injuries happen frequently, and it is possible to fall into the sea. The more wind and waves, the more difficult and dangerous is the operation. Procedures say that the fishfarmers ought to attach a specially purchased *basket* to the crane. This will reduce the risk of falling into the sea or get spiked by the pole. But to get room for the sacks of fodder they have left the basket on shore. If our fishfarmers are to do the operation according to procedures, they have to go back to the quay to unload the fodder sacks, get the basket on board, drive back and do the reparation and then get to the quay and load the fodder again, to continue the feeding process they started hours ago. Our fishfarmers are conscious that if they follow procedures the fish will starve for hours and the fishfarmers will have to work overtime – and it might become a hole in the net under water before they manage to fix the damage. Our fishfarmers do not need to ask someone if it is better to do a shortcut than to face an escape (or a lot of extra work and overtime). They do not need to make a list and weigh the risks and gains. The fish is first priority, so they know that they will choose the fastest alternative possible without losing lives or limbs. They just look at each other and know what the decision is going to be. Almost without words, they improvise a homemade basket and repair the damage perfectly without special purchased tools or procedures, but not without risk.

4.2. Operation 2: The well boat crew is ordered to get the fish fast to the harvesting plant. How to handle complex tasks and time pressure?

When a salmon is about 2.5 years old it is delivered to the harvesting plant to be slaughtered. Most fish farms use a well boat as transportation. We will now take a closer look at an example of a typical well boat delivery: The management at the fish farm orders the slaughtering pickup weeks before. To navigate the well boat to the net cage and load the fish into the well boat can involve ample loss even on a clear day. Because the well boat has to fit in the many fish farms in their tight schedule, they have to work nights and in stormy weather. When the experienced fishfarmers get to know the time for the well boat arrival, they therefore prepare the net cage thoroughly. One of our fishfarmers tells how they avoid danger:

It's possible to take precautions. If we're going to 'slaughter' in the night we'll make everything ready before we go home in the afternoon. We prepare before the boat arrives. We're only two when we deliver, so we don't have time for anything but the regular tasks.

The fishfarmers also have to loosen moorings on the net cages to get room for the big well boat. Some people say that others perceive this as easy and safe, when in fact it is dangerous:

To loosen the moorings, that's an operation where there's some risk involved. If the weather's bad when you're doing it, it'll be pressure on the ropes. Something can snap, and everything moves. The boat is moving, the crane is moving, the sea is moving, everything moves in opposite directions. There's contact with the things you're untying, there're fasteners which should be loosened, there's a great danger of trapping. But we've formed this to be a routine operation, and therefore we don't see it as dangerous any more. That's where the risk is. If you talk to someone on another location, he'll not consider it dangerous at all.

Fishfarmers always consider the risk of accidental loss when they start an operation. Dead or damaged fish can lead to economic failure for the fish farm. Uneasy conditions make the fish hurt themselves on the way from the net cage to the well boat. This is told by a boat captain:

Ordinarily it's wind that stops us from entering, but sometimes it's waves. But then it's seldom problems for us, but for the fish. Because of the movement in the net cage it's not favourable to load because of the quality of the fish.

If the operation is delayed it will lead to problems at the harvesting plant, which can transfer to 'the costumer in China', and the fishfarmers have felt much pressure from the management.

I've had some phone calls: 'Is it only girls at your unit?' Then I have to say: 'Just put on your rainwear and come help' [. . .] It seems so easy for persons sitting in an office. They know we need the fish, angry customers are waiting . . . but they have no idea of what's happening on the net cage. So they start yelling at us. That's wrong.

Our fishfarmers mean that the time pressure used to influence their decisions, but that safety awareness has improved in the fish farm industry the last years, because the authorities have stressed the companies to regulate their safety procedures and safety awareness. Both fishfarmers and boat crews make sure that they take the time needed to do the task properly, even when they are behind schedule.

It's not possible to hurry at sea. [. . .] So we must take care of the fish until it's in the box at the harvest plant. We can't afford to play around with the fish, so we can't move to fast.

The fishfarmers and seamen state that it is ironic that the employers implicitly urge the employees to work fast, because they know that haste makes waste. Instead the crews underline support from and discussions with co-workers as important for each decision. The decisions are made collectively by the operational fishfarmers and the well boat captain. In the situation described with much wind and waves and the fish' health at stake,

the fishfarmers care less about pressure from management or a bigger workload. They postpone the operation for some hours. As a result they also minimize the risk of personnel injuries.

> *We're all a part of the decision-making, in cooperation with the captain. It was really the captain that came to us and said it wasn't weather to keep on with the operation. And I think it was the right decision.*

5. Discussion

The empirical data from the two operations can be compared with decision models (Rosness, 2009; Rasmussen, 1986; Klein, 1993) to find criteria and constraints for decision-making at fish farms. To recapture the two situations: In operation 1 the fishfarmers are feeding the fish and discover possibilities for net damages. They have to decide how to repair this and still be able to continue feeding (the alternatives they have in mind are whether to spend time getting the basket according to procedures or make something by themselves). The men choose to improvise – to minimize risk of harm for the fish and overtime for themselves. In operation 2 the fishfarmers are delivering fish to the tightly scheduled well boat, and they must decide if the weather can lead to injured fish (should they continue the operation or stop). The fishfarmers and the well boat captain decide to stop – to minimize risk of harm for the fish, which also mean less risk for the men. I will now try to translate and analyze these two moments of decision-making into words we can use to understand constraints and criteria important in the very minute the operational personnel make their decision.

Both operations 1 and 2 have the characteristics of recognition-based and skill- and rule-based decision-modes (Klein, 1993; Rasmussen, 1986, 1997). The decision-making fishermen are experienced and must make instant decisions. They know by heart the action alternatives available, and use information from the running context to find the best alternative. On the other hand, the decision-making and problem solving is also slightly analytic and knowledge-based in operation 2, where the crews almost weigh pros and cons about the weather, time pressure, and safety for the fish. The difference in decision mode can be due to differences in the process of determining what is best for the product. In operation 1 it is clear that the fish need to be fed as fast as possible and that the net cage must be repaired quickly to prevent escape, while in operation 2 the actors must continuously consider the risk of harm.

In both operations the fishfarmers have much freedom and are expected to take responsibility for safety and profit. In a personnel safety perspective, the decision in operation 2 appears 'right' because it leads to personnel safety, while the decision in operation 1 seems more irrational and reckless due to the possibility of harming the persons involved – but an inspection of the operational personnel's criteria and constrains can show the rationale behind (Rosness, 2009, see Table 1 for the theory overview).

Limited situation awareness constrains the decision-making in operation 1 because our fishfarmers do not know if the net will be damaged before they get back to repair it, and in operation 2 because it is hard to determine how the fish reacts to the weather this day.

The fishfarmers' *workload* is also a constraint for the decision-making in operation 1. *Acceptable workload* constitutes a decision criterion because the fishfarmers have the possibility to go back to shore to get the basket, but that would constitute an unacceptable workload. The weighing reason why the fishfarmers do not turn around to get the basket, however, is the most important decision criterion: to take care of the fish. In operation 2 the actors involved actually choose to create *more* work for themselves to eliminate the risk of loss. When the theory overview includes a criterion of acceptable workload (see Table 1), it implies that it is *possible* to be slipshod, although most craftsmanship is impossible to do 'half way'. It is established that employees regularly face a dilemma between thoroughness and efficiency (Hollnagel, 2009). Prior research often defines 'efficiency' as fast, i.e. when managers pressure towards time saving actions that can harm product or employees. When the operational setting consists of craftsmen – as the fishfarmers – it is necessary to employ a broader meaning of the 'efficiency' term: The action is effective if it profits in the long run. Fast reparation is good in the long run in operation 1, so 'efficiency' here means to work rapid and save time. This is in contrast to operation 2, where everything is done thoroughly for the fish' sake, without thoughts of workload or effort put in, because thoroughness makes a healthy biological product which makes profit. It is not effective to rush during the harvesting of a product you have used years to breed. The fishfarmer's view of efficiency is to maintain the flow of the fish. This shows that *smooth and efficient operations* are the most important criteria in both operations, meaning that smooth for the fish is cost efficient in the long run. It points out that there are several nuances in the meanings of efficiency and thoroughness – in certain operations efficiency-thoroughness trade-off does not exist.

In the decision about cancelling the operation in operation 2, close relations with and support from co-workers are essential and can constrain the decision-making greatly if not present. In operation 1 the fishfarmers also emphasize that they learn about different solutions through discussions with colleagues. These relations are not explicitly mentioned in the models about decision-making, although it is possible it lies within the terms *skills, knowledge* and *experience* (Klein, 1993; Rasmussen, 1986).

Apart from the indistinct efficiency definition and the importance of team relations and support, Rosness' overview over criteria and constraints for the decision-making are well suited to understand decision-making in the fish farm operations. The exact *decisions* in the two exemplified situations cannot be generalized to all fish farms, but the *operations and framework conditions* are quite similar for most salmon farms, at least in Scotland (Georgakopoulos and Thomson, 2008) and Norway. A summarization of the criteria, constraints and modes for the decision-making for each operation in Table 2 has a couple of differences from Table 1.

Both example operations from the fish farms show that the fish are given first priority; the fishfarmers' own safety comes second. A biological production process sets criteria for decision-processes and makes safety-work even more difficult. It is not possible to push a stop button or to put everything on hold and do a detailed risk assessment. The live product determine whether the process can move fast or slow, otherwise the fish farm can face fish illness, death, escape or other major environmental accidents. In most *daily* sharp end operations at a fish farm, it serves the product to work fast: So the fishfarmers feed when scheduled and perform reparations the moment damages are discovered. In all operations involving *moving* live fish, which happens only a few times for each fish, it is required to take it easy and avoid bad weather and other hazardous conditions, so they do. This fishfarmers are flexible and responds to disruptions, watches for threats, foresees developments and learns from experience (as urged by Hollnagel et al. (2006, 2011)) with the main decision criterion: smooth operations for the fish.

Even though the personnel set the product first in both the empirical situations described, it has different safety implications. In operation 1 it results in a decision which can lead to personnel injuries, while in operation 2 stopping of the operation reduces the risk of personnel injury. Fig. 2 illustrates how the fishfarmers pri-

Table 2
Decision criteria and constraints in fish farm operations.

Situation	Decision alternatives	Goal	Constraints on decision-making	Decision-criteria	Decision modes
Net cage damage is discovered during feeding	– Follow procedures – Improvise	– Live product must not escape – Live product needs food	– Workload – Limited situation awareness – Relations and support	– Acceptable workload – Smooth and efficient operation	– Recognition-primed – Skill- and rule-based
Well boat must bring fish fast to harvesting plant while weather is bad	– Carry through with delivery – Stop the operation	Live product must not get injured	– Limited situation awareness – Team relations and support	– Smooth and efficient operation	– Recognition-primed – Skill- and ruled-based intermittently interrupted by knowledge-based

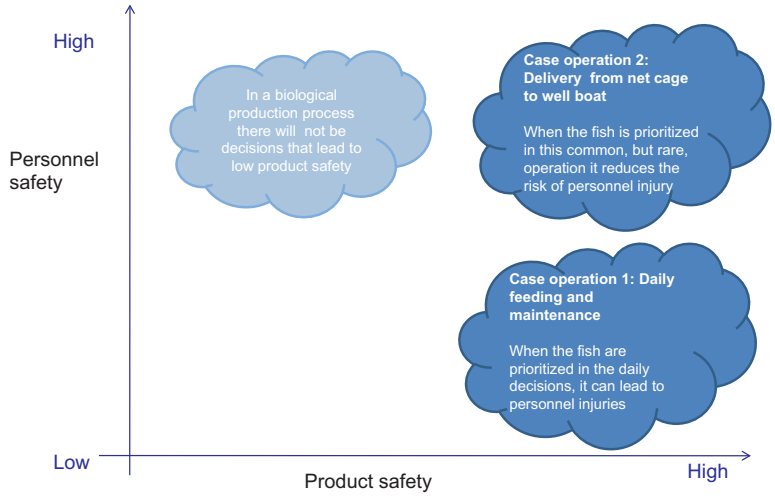

Fig. 2. Product safety is often prioritized in fish farm operations.

oritize high product safety in the two operations, and that this leads to various personnel safety.

It might be possible to interpret Fig. 2 and the empirical data as an indication that personnel safety will be low in daily operations and high in the more rare well boat operations as long as the fish has first priority. For the fish' sake the fishfarmers are trained to anticipate trouble, find solutions out of previous learning, adjust to change and stabilize instable situations. In the daily operations this 'resilience' increases the personnel risk instead of improving their safety, because fast problem handling conflicts with personnel safety.

It is accepted that production and safety often will collide (Hollnagel et al., 2006, 2011). Yet, in fishfarming prioritizing production often equals environmental safety, which again collides with personnel safety. Even if fish farm organizations were great at learning, responding, monitoring and anticipating (Hollnagel et al., 2006, 2011), they would struggle to prevent all accidents in daily operations.

The prioritization of the biological product, in favor of environmental safety, which conflict with personnel safety in daily operations, could explain why there are so many accidents in the aquaculture industry, and that most happen during simple day to day operations, even though fishfarmers' overall workpattern can be resilient.

A remedy for this paradox seems inaccessible: Maybe work tasks on the net cages can be automatized, but as long as fish lives in the sea the fishfarmers will be exposed for bad weather and the terror of a massive fish escape will threaten. Fish farm organizations might be safer for personnel, fish, and environment if they implemented a kind of resilience engineering or other safety measures. Still – if we cannot find out how to balance safety for personnel and environment – fishfarmers have to choose between the two.

6. Concluding remarks

In this paper criteria and constraints for sharp end decision-making in core operations at Norwegian fish farms are described and discussed. The results generally correspond with elements of the overview on dominant constraints and decision criteria in the operational decision setting from other industries. Still, some details are debated: Lack of team relations can constrain the decision-making, and there are different definitions of the term efficiency.

The most important criteria in the sharp end operations at *fish farms* are, however, to keep the fish healthy, alive and at the right place. This constitutes smooth and efficient operations. Even though the criteria and constraints largely coincide between the two studied situations, the implication for personnel safety is not similar. During moving of the fish accidents are well prevented (despite time pressure) because the operation must be performed carefully for the fish' sake – while in the *daily* operations there are major time pressure for the fish' sake, and room for the personnel to make fast 'idiot decisions'.

An explanation of the high number of accidents in daily sharp end operations at fish farms can be the need to urgently prioritize

the live product, which in certain operations collides with personnel safety. The fish' biological rhythm controls the work process; to get the best product or avoid environmental disaster the fish must be cared for in its time. Even though formal procedures and traditional safety measures do not take this into account, the operating fishfarmers are responsible of prioritizing the fish. They are and must be skilful self-governed craftsmen, which make decision that are best for fish and environment – and at the same time take personnel safety precautions.

This logic might apply to other industries with biological or flowing production processes, where an unstoppable process is the center of attention. When fish comes first it does not matter for the personal safety if the organization is resilient. We need to find out how personnel safety can correspond with environment and product safety, not only by accident.

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