# Reintroducing the sharp-end operator to organizational learning: How accident reports are used by maritime officers

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| A R T I C L E I N F O | A B S T R A C T |
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| | When accidents occur in the maritime domain substantial efforts are devoted to their investigations in order to improve safety at sea. Investigations often result in detailed and elaborate descriptions of the sequence of events and root cause factors in the form of accident reports. Investigations carried out by governmental investigative bodies are made available in public reports, and typically contain safety recommendations intended to facilitate learning at individual, organizational and institutional levels. Several studies explore how accident reports are used for organizational learning, however, less discuss how sharp-end operators utilize this information as a tool for learning. This exploratory study interviews 18 Norwegian deck officers to better understand how seafarers acquire, use and value maritime accident investigation information as a means for developing their own professional practice. Results indicate a relatively low rate of utilization of original accident reports. The deck officers detailed barriers in format and scope of accident reports that limited their interest in them as a learning tool, favouring alternative sources, formats and transformed information which focuses on storytelling and a narrative-driven style more relatable to their specific work practices and backgrounds. |

## 1. Introduction

The maritime domain and associated operations are an inherently dangerous and complex work environment. While advancements and standardization of regulations, engineering and technology, operational procedures and training have facilitated vast improvements in maritime safety, accidents at sea continue to occur (AGCS, 2012; 2019). Systematic accident investigations seek to understand how and why unwanted events happen, with an objective to prevent future occurrences (IMO, 2008; NSIA, 2020). Thus, an accident investigation and its outputs are tools for reflection, analysis, understanding and learning. Dekker (2014b) argues the prevention of future occurrences is often the most important, if not the only, purpose of accident investigations. When accidents occur, they represent an opportunity for various entities to improve through lessons-learned and experience gained (Hollnagel, 2014; Kjellén, 2000).

Accident investigations deemed significant enough to be initiated by public bodies, such as government agencies, conduct independent investigations in order to identify and communicate important safety deficiencies and create recommendations designed to eliminate or reduce the safety deficiencies discovered (MAIIF, 2019; TSBC, 2020). The International Maritime Organization's Casualty Investigation Code (IMO, 2008) has established criteria for the types of marine accidents requiring investigation, including prescribed procedures to follow for events, such as death or serious injury, the loss of persons from a ship, loss or abandonment of a ship, material damage or damage to the environment.

Sharp-end operators in safety–critical systems, such as seafarers, play an important role in shipping and the management and implementation of safe operations. As such, their competencies and training are an important aspect of system safety. As the primary purpose of accident investigations are to contribute to improving safety and accident prevention (NSIA, 2020; TSBC, 2020) the seafarers themselves are a logical audience for the results and outcomes of accident investigations as a form of knowledge transfer. However, utilization of accident investigation reports (henceforth referred to as "accident reports") by sharp-end operators may be inhibited for a variety of reasons. A major contributing factor for failure of dissemination is that reports are too long and are not written in a sufficiently accessible language (Johnson, 2002), whilst information produced by the various investigation stakeholders can be scattered and difficult to use (Vepsäläinen & Lappalainen,

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2010). Thus, sharp-end operators may not perceive a report as useful or relevant to them, viewing accident reports as mainly aimed at providing statistics for managers, rather than being a source for learning (ESReDA, 2015). Vepsäläinen & Lappalainen (2010) note that seafarers value storytelling and seamanship as important safety management tools for learning, whilst shipping company managers and administrators desire a more systematic and broad perspective on safety issues. Dissemination of report material also connects to the level of access and confidentiality of the information. Pomeroy & Earthy (2017) point out that there is much knowledge contained within internal reports that would be beneficial for improving safety if it were available to a greater audience. Although research in the field of how organizations learn from accidents is well established (Silva et al., 2017), less research has been performed on how accident investigations and reports are actually disseminated and reach sharp-end operators (Lindberg et al., 2010; Vepsäläinen & Lappalainen, 2010). Furthermore, how sharp-end operators perceive and use (or do not use) information from accident investigations is not well established. Thus, in a multilevel learning perspective of accidents (Hovden et al., 2011) strengthening the connection and understanding of individuals and their perspectives, perceived value and utilization of accident reports with company, sector and authority levels can improve overall outcomes and contribute to improved organizational learning from accidents.

Accident reports are a form of knowledge capture and potential tool for knowledge transfer leading to learning and future prevention (Dekker, 2014b). However, the literature has detailed differing barriers which may be inhibiting sharp-end operator's utilization of knowledge from accidents and their subsequent investigations because of the characteristics of the typical formal artefact of accident investigation: the accident report itself. This paper uses an exploratory approach to better understand the role of accident–related information, in the form of discursive artefacts, and how these narratives may support deck officer's work practice. By performing semi-structured interviews with maritime deck officers we aim to identify the mechanisms for how and why deck officers acquire, use and see value in maritime accident reports. The following research questions are posed:

RQ1: How do deck officers *acquire* accident reports?
RQ2: How do deck officers *use* accident reports?
RQ3: How do deck officers *perceive* the value of accident reports?

By exploring how deck officers interact with accident reports we wish to illuminate the connection between the individual and organizational level in relation to multilevel learning, whilst identifying gaps and opportunities for more effective learning and knowledge transfer. The goal is to point to more effective methods of disseminating knowledge from accident investigations and outcomes to the sharp-end operator.

The outline of the article is as follows: Section two provides background information and the theoretical framework used by presenting current knowledge on learning from a safety perspective with an emphasis on accident investigations and outcomes as tools for learning. Section three presents the methodology implemented for data collection and analysis. Section four presents the results of the data collection, organized and presented in accordance with the article's three research questions. Section five discusses the results and connects them to the wider body of literature, focusing on the access and use of accident reports by deck officers, the impact of secondary sources and the paradox found in accident reports use value for deck officers. The conclusions section summarizes the article's main points and provides recommendations for future research and application.

## 2. Theoretical framework

To better understand how deck officers learn and maintain a safe work practice we begin this section by exploring theories about professional groups that have specialised expertise, such as seafarers. We link this to discursive practice and the role of accidents as learning opportunities for improvement, and the role of storytelling and sense-making narratives for professional reflection and learning.

### 2.1. Professional practice and learning

Deck officers are leaders at the *sharp-end* (Flin et al., 2008; Salas et al., 2004) of a shipping company and are directly exposed to the dangers associated with work together with the rest of the crew. These officers have very specialized expertise. The process of acquiring good ship handling skills (i.e. sailing, manoeuvring and positioning a ship) requires lengthy and demanding training that usually contains several years of schooling and apprenticeship, including a cadet period in order to gain real-world training and experience onboard ships. The *International Convention on Standards of Training, Certification and Watchkeeping for Seafarers* (STCW 1978, as amended) implemented by the International Maritime Organization specifies minimum qualifications of seafarers worldwide across differing professions and ranks (IMO, 2011). Furthermore, working within certain sectors or ship types, with specialized equipment or within specific regional or national jurisdictions also necessitates additional certification. This may include mandatory sector-specific training or periodic retraining, completion of minimum time working at sea and/or medical checks in order to qualify for, maintain or be promoted to differing positions (IMO, 2009; 2011). However, seafarer competence goes beyond the highly structured and codified education, training and certification framework covering demonstrable and explicit knowledge and skills, including development of more tacit knowledge consisting of cognitive and perceptual capabilities described as "shipsense" (Prison et al., 2013) or "seamanship" (Kongsvik et al., 2020). These are associated with certain individual skills and specialized knowledge related to ship handling and maritime operations, whilst also extending to work ethics, obligations to fellow seafarers, the ability to make sound judgements and what is considered safe work practice and professional norms in a wider maritime community of practice (Kongsvik et al., 2020). Therefore, as a newly certified third officers gradually climb the professional ladder to reach the rank of ship master (i.e. ship captain) an officer must meet both the formal requirement for certification but also the less tangible skills understood to be a part of "good seamanship" and safety knowledge. Safety knowledge is deeply rooted in individual and collective identity and is primarily knowledge that is tacit and taken for granted (Gherardi, 2017). She states that "*safety is emergent from the working practices of a community; it is a collective knowledgeable doing and is embedded in the practices that perform it*" (Gherardi, 2017). Hung & Cheng (2002) argue that this enculturation within a community is "*learning to be*" and different from "*learning about*", which can be described as acquiring technical knowledge needed for ship handling.

Gherardi (2017) explains that everyday safety is based on the use of material and discursive artefacts, and that language is an essential instrument in this process. Dailey & Browning (2014) claim that narratives between members of an organization can be used to create shared identity, culture and practices based on lessons learned to form, reinforce or change behavior. Goodwin (1994) demonstrates in his analysis of lawyers, policemen and archeologists how discursive practices structure the lifeworld of these professionals and directs their professional scrutiny. He states that "*The shaping process creates the objects of knowledge that become the insignia of a profession's craft: the theories, artifacts, and bodies of expertise that distinguish it from other professions*" (Goodwin, 1994). Following Gherardi (2017), deck officer's safety knowledge needs to be considered as a social and collective accomplishment rooted in a context of interaction, situated in a system of ongoing practices and learned through participation in a maritime community. This process of becoming and maintaining a professional community membership creates what Helmreich & Merritt (1998) describe as professional culture "*manifested in its members by a sense of*

*community and by the bonds of a common identity"*. They claim that what is learned by being part of a professional culture can have a stronger impact on safety practice among sharp-end operators than organizational culture. It is therefore interesting to investigate organizational safety from a social perspective in the maritime trade that is characterized by professional communities, such as deck officers, and more generally, seafarers and seafaring.

## 2.2. Accidents as learning opportunities

Accidents are opportunities for learning (Hollnagel, 2014), whilst their traditional outputs, such as accident reports, are tools to facilitate knowledge capture and transfer of information to facilitate learning amongst relevant parties (Dekker, 2014b). This perspective stands in stark contrast to a "blame culture" of accidents and accident investigating (Dekker, 2014a) where a poor safety culture manifests in ignoring or underreporting safety issues or events, thus losing opportunities for individuals and organizations to learn and improve (ESReDA, 2015; Probst et al., 2008). Even if accident investigations have been criticized for being based on hindsight and a biased focus on what can go wrong (Dekker, 2014a) accident investigations and reporting are a central principle in contemporary safety management systems, such as the International Safety Management Code in the maritime community (IMO, 2014).

Learning is considered crucial for resilient performance in complex systems (Hollnagel, 2017; Patriarca et al., 2018). Le Coze (2013) comments that the literature on how to learn from accidents contains a wide range of approaches, interests and outcomes. Reason (1997) uses the term "*learning culture*", linking this concept to an "*informed culture*" in his seminal work on managing the risks of organizational accidents. He points to the importance of those "*who manage and operate the system have current knowledge about human, technical, organizational and environmental factors that determine the safety of the system as a whole*" (Reason, 1997). This indicates that system operators, such as deck officers, must learn to understand and respect the hazards facing their trade, and thus become alert to the many ways in which a system's defenses can be breached or bypassed.

The Resilience Engineering perspective highlights four abilities in a resilient system (Hollnagel et al., 2011; Hollnagel, 2017): (i) the ability to respond to regular and irregular threats in a robust, yet flexible manner; (ii) the ability to monitor what is going on, including its own performance; (iii) the ability to anticipate disruptions, as well as the consequences of adverse events; and (iv) the ability to learn from experienced successes and failures. Learning from experience can be related to both the individual level (e.g. knowledge, skills and attitudes) and the institutional level (e.g. rules, procedures and policies). Thus, a resilient system must be able to improve both individual and institutional knowledge (Hollnagel, 2009). According to Praetorius et al. (2015) the four abilities are mutually dependent, each representing one facet of a system's functioning. They describe anticipation, responding and monitoring as core tasks in maritime traffic management and demonstrate how learning affects these and the ability to operate under a variety of conditions without major performance drops. Hollnagel (2017) defines learning as "*the ways in which an organization modifies or acquires new knowledge, competencies and skills*". He emphasizes that learning is incremental, shaped by previous knowledge and to be understood as an active process of development rather than as a passive collection of facts and knowledge. According to Hollnagel (2017), a basic prerequisite for learning on the organizational level is a competent staff. Thus, organizational learning depends on individual learning that can be deposited on the organizational level, and influence on the ability to anticipate, monitor and respond.

All accounts of accidents can be regarded as narratives, as they involve a temporal sequence of events and actions (Rae, 2016). In order to recognize and interpret signs of potential danger deck officers use interpretive schemes based on their experience, training, culture and identity as professionals. These are frames of action that enable effective decision making in critical and stressful situations (Klein, 2008; Weick, 1993; 1995). However, these interpretative schemes need to be combined with what Pidgeon & O'Leary (2000) describe as "safety imagination" in order to challenge assumptions and uncover safer or more effective solutions to ill-defined hazards.

Although seafarers value storytelling for learning about safety (Vepsäläinen & Lappalainen, 2010), storytelling is often overlooked in incident investigations, and thus reduces the opportunity to reflect on possible risk prone actions in one's own work practices (Hayes & Maslen, 2018). Hayes & Maslen (2018) argue that storytelling is a critical factor in professionals' learning as it develops their safety imagination and improves risk management, linking their everyday practice to possible dangers. Rae (2016) demonstrates how storytelling about accidents is an intrinsic part of the education of safety professionals and finds that sensemaking about risk is a common theme in accident narratives. Sensemaking seeks to create order and make retrospective sense of events that occur through past experiences (Weick, 1993). It is an ongoing social process where professionals create and share plausible meanings and understandings of dangerous conditions through construction of shared stories (Weick, 1993; 1995).

In reflecting retrospectively on an inquiry of an unwanted or negative event Dwyer et al. (2021) describes the process of "post-inquiry sensemaking". Differences of opinion and perspectives of an accident investigation and its related recommendations are common and the implications for specific work practices are often complex, confusing and conflictual. This creates equivocality that enables post-inquiry sensemaking over time across four distinct phases (Dwyer et al., 2021): (i) retrospective sensemaking, allows practitioners to question existing professional assumptions that contributed to the accident; (ii) retrospective and prospective sensemaking, allows practitioners to develop new tools and technologies to address shortcomings in their practice; (iii) retrospective and prospective sensemaking, changes meanings of work to incorporate new tools and technologies; (iv) prospective sensemaking, allows the practitioners to speculate on whether the new tools, technologies and meanings will mitigate the risk for future accidents.

As pointed out by Le Coze (2015) in his reflection on the legacy of Jens Rasmussen, investigations can have three overarching goals: explanation (theorizing), allocation of responsibility (finding people to blame) and system improvement (learning). Rasmussen was a pioneer in the work of systemic accident analysis and in explaining human error in a sociotechnical perspective (Le Coze, 2015; Waterson et al., 2017). His well-known AcciMap tool, the model of risk management and the model depicting the dynamic boundaries of safe performance all demonstrate the importance of interaction between the different actors in a sociotechnical system (Rasmussen, 1997). Rasmussen (1997) explains that organization learning at all levels is needed to ensure an adaptive system and point to the importance of appropriate language in this process stating that "*It is not enough for a change in plans or actions to occur: the entire organisation must be made aware of it, and aware of its implications for the various levels and subgroups within the organisation, in each case in a language appropriate to the kind of decisions which need to be made by that part of the organisation*".

Hovden et al. (2011) studied multilevel learning based on formal reports, specifying two dimensions: (1) where the learning takes place specified as levels of (i) individual, (ii) company, (iii) trade and (iv) authorities (in accordance with Rasmussen [1997]); (2) how different types of learning take place as feedback loops within and between the different levels. It was found that the accident reports had a considerable impact in directly and indirectly creating motivation for change, such as the development for new regulations and policies, but it was more difficult to document the impact on the safety performance amongst sharp-end operators (Hovden et al., 2011). Accident reports are intended to highlight safety concerns and point to lessons learned from both near misses and accidents forming the basis for learning in risk prone

industries (Kjellèn & Albrechtsen, 2017), however have been noted to be underutilized by sharp-end operators (Johnson, 2002; Pomeroy & Earthy, 2017; Vepsäläinen & Lappalainen, 2010). Thus, a disconnect may exist between the accident investigation outputs and learning outcomes (i.e. the reports and their information) and sharp-end operators, creating a broken link between utilizing adverse events as learning opportunities and overall system safety. This article sets out to explore the role of accident–related information as discursive artefacts and how these narratives may support deck officer's work practice.

## 3. Method

### 3.1. Procedure

This study uses interviews to collect descriptive data from sharp-end operators in the maritime domain (as subject-matter experts). The interviews followed a semi-structured question script that focused on three main topics in accordance with the research questions:

1) How deck officers *acquire* accident reports
2) How deck officers *use* accident reports
3) How deck officers *perceive* the value of accident reports

The format allowed for more descriptive responses and dialogue, whilst creating opportunities for both the informant and interviewer to clarify, rephrase and follow-up on questions and themes. This created an environment that facilitated mutual understanding and increased accuracy in data (Dörnyei, 2007). The interviews were conducted individually both via telephone (n=15) and in-person (n=3) using identical procedures and question script (Aas, 2020). Interviews were audio recorded and transcribed verbatim post-hoc. All interviews were performed in the Norwegian language and translated to English during the transcription process prior to data analysis. Every effort was made to provide accurate language translation and keep original meaning and subtleties of informant responses intact in translation. All informants were sent an information letter prior to their interview session and the researchers obtained informed consent prior to beginning the interview process. This research project and the interview questions were registered and approved by the Norwegian Centre for Research Data (project no. 221847).

### 3.2. Informants

Eighteen informants (Age: $\bar{x}$=27.5 yrs; σ=2.67 yrs; Max=33 yrs; Min=23 yrs) were recruited through non-probability sampling (convenience and snowball sampling techniques). Inclusion criteria required that only individuals holding the relevant training and valid licenses which qualified them for service as deck officers were eligible to participate in the study. All informants were Norwegian, having between one and eight years of working experience at sea ($\bar{x}$=3.5 yrs; σ=2.5 yrs) holding varying professional positions across a number of maritime sectors (see Table 1). Informants were all licensed deck officers at the time of the interview who were working across several companies, industry sectors and types of ships. Although, this represents diversity within the informant sample, the specialty of their profession, educational level and background, nationality, age range and language created a relatively homogenous sample.

### 3.3. Data analysis

Data analysis utilized an inductive coding framework, where informant responses were categorized into meaningful categories (Payne & Payne, 2004). Thematic analysis was implemented (Braun & Clarke, 2006) in order to systematically generate a first round of broad coding. This was performed shortly after each individual interview to get familiarized with the data and begin generating initial codes. As data

**Table 1**
Informant demographics.

| | | n | % |
|---|---|---|---|
| Gender | Female | 4 | 22.2 |
| | Male | 14 | 77.8 |
| Age (years) | 20–25 | 6 | 33.3 |
| | 26–30 | 10 | 55.6 |
| | 31–35 | 2 | 11.1 |
| Position | Chief Officer | 3 | 16.7 |
| | First Officer | 2 | 11.1 |
| | Second Officer | 5 | 27.8 |
| | Third Officer | 1 | 5.6 |
| | Officer (unspecified) | 2 | 11.1 |
| | Licensed | 5 | 27.8 |
| Work Experience (years at sea) | 0–2 | 10 | 55.6 |
| | 3–4 | 3 | 16.7 |
| | 5–6 | 1 | 5.6 |
| | 7–8 | 4 | 22.2 |
| Sector | Offshore | 6 | 33.3 |
| | Cruise/Passenger | 4 | 22.2 |
| | Navy/Coast Guard | 3 | 16.7 |
| | General Cargo | 2 | 11.1 |
| | Commercial Fishing | 2 | 11.1 |
| | Tanker | 1 | 5.6 |

collection continued subsequent analyses of the initially established broad coding categories were developed into more specific themes. Once data saturation was reached the finalized themes were established and data collection ceased (Saunders et al., 2018).

## 4. Results

The aim of this explorative study is to investigate how maritime deck officers acquire, use and perceive the value of accident reports. The results are organized into two sections. The first section presents how informants reported using a variety of information sources to acquire knowledge about accidents and accident investigation information. How deck officers use and value this information are presented in the second section.

### 4.1. Information sources

Research Question 1 (RQ1) seeks to better understand *how* deck officers acquire accident reports in order to map what and where information is obtained. The informants described the differing channels where accident reports and associated information are published, as well as alternative information sources that they use to learn about accidents. Many of the informants explained that accident information was not limited to the official accident reports, but extended to a combination of differing sources, including various forms of accident-related information from their employer (through company generated short summaries, case studies, safety meetings, other documentation, etc.), peer-group and professional networks, as well as from traditional media and social media. Informants also described how this information is obtained in both an "active" and "passive" manner. "Active" describes the deck officers personally seeking out information on their own initiative and discretion, potentially in their free time, whilst "passive" refers to the information, to a great extent, provided to them or organized by their employer or through work-related requirements (e.g. mandatory meetings, education and training, recertification, promotion, etc.). Table 2 provides an overview of information sources reported by the informants.

During the semi-structured interviews informants, to a large degree, did not distinguish between formal accident reports carried out by national investigation boards from company-specific incident investigations or internal reports. All informants reported knowing the differences between the reports, but did not make specific distinctions between them or the information obtained unless asked to specify within

**Table 2**
Overview of information sources informants reported using.

| Information Source | Content Creator and/or Disseminator | Format |
|---|---|---|
| Official investigation report | Accident investigation body | Original text documenting the accident investigation |
| Safety flash | Professional societies (e.g. IMCA, unions, etc.) | Summaries based on the official investigation report, either accessed directly from IMCA web page or made available by their company |
| Employer digital newsletter | Shipping company | Summary information about accidents (internal and/or public information) sent to employees by e-mail or intranet |
| Onboard physical documentation | Shipping company | Printed copies of newsletters, including safety flashes and/or other sources |
| Mandatory onboard safety meetings | Shipping company | Presentation and discussion of reports to crew facilitated by safety officer |
| Media (print, digital, TV) | National and international media firms | Stories about the accident prior to and/or after the formal investigation of published report |
| Social media | Personal accounts (e.g. Facebook, Twitter, etc.) | Stories or personal opinions about the accident prior to and/or after the formal investigation of published report |
| Informal discussion and storytelling | Peers | Stories and/or personal opinions shared by professional network and onboard colleagues |

the interviews. Rather, informants tended to refer to "reports" in more general terms, which ranged from the breadth of information sources, as presented in Table 2. One of the reasons proposed by an informant for this is that the lessons learned and narrative from accident investigation *reporting* (which must be distinguished from the official accident report itself) is potentially more important and useful to sharp-end operators than the original source. Furthermore, accident summaries provided by secondary sources, such as professional societies or one's employer, were reported by informants to be formal and trustworthy, essentially providing a "service" of summarizing long and/or complex reports into useful information and learnings for them.

Eight informants described receiving official accident reports from their employer, seven reported only to receive internal company reports, with three describing receiving little to no information or materials related to accidents or accident reports. The informants that reported receiving official accident report material, as provided by an employer, were delivered in differing formats (e.g. through documentation, meetings or a combination), and from differing employees within the organization (e.g. captains, senior officers and/or safety representatives). One deck officer exemplified this by saying: *"The captain distributes* it [accident reports] *to us, the deck officers, so that we can go through it. We usually have a meeting where we have to sign that we have read the accident report"* (Informant 6). Several informants noted that it was common for accident material to be displayed in a visible place onboard: *"It* [accident reports] *come through a local system. The captain usually prints it out and displays it at the bridge"* (Informant 11). Furthermore, it was described that obligatory safety meetings for crewmembers were used as arenas to analyse and discuss accidents and relevant reports together as a group: *"The HSE* [Health, Safety and Environment Officer] *responsible aboard goes through these reports, and then it spawns some discussion and reflections"* (Informant 11). It was pointed out by the informants that their safety meeting accident discussions typically focus on accidents that occur with similar vessels or operations as to the one they work on (Informant 8).

The informants explained that accident information was not limited to the accident reports themselves, but extended to internal company documentation and reports, summary statements and case studies which

were delivered through written reports or meetings, as well as more generally through differing formal and informal media and communication sources. Regardless of where the material stemmed from (i.e. official accident investigation reports, internal company material, etc.) content was predominantly presented in the form of written summaries (of approximately 1–3 pages of written text in length). Policies and routines varied greatly between informants and maritime sectors they worked within, with information being delivered from differing sources, in differing formats, and with varying levels of formality. It was reported that the original accident reports were found to be seldom read by the informants, rather they rely on the condensed information in safety bulletins, safety meetings or what is discussed amongst colleagues.

Seven of the informants described how they actively seek out official accident reports on their own initiative, whilst eleven reported seldom or never having done so throughout their career. However, ten informants reported that they received or sought out information and insight about maritime incidents and accidents through differing media channels. This included not only regional, national and international traditional news agencies, but also maritime-specific media sources and online social media. Several informants mentioned how they would typically be made aware of cases initially through the media, potentially leading them to follow-up through their own initiative if their interest was piqued. One informant noted: *"Well… first I must be aware that an accident has occurred. And that's typically something you hear in the media or, yeah… media or social media. Then one goes in and read the headlines there. If it catches my interest, it can happen that I go a little in depth and see if there's more written about it"* (Informant 18).

Furthermore, many informants also described how various cases, such as maritime-related accidents or discussions in the media could be themes for informal conversations and discussion between colleagues. Thus, accidents, associated outcomes and larger industry or societal discussions around such events are used as a platform for discussion and debate between the sharp-end operators. These can exist outside of formal mechanisms, such as written reports, text summaries or safety meetings typically used by companies or governing bodies to deliver such information to employees and sharp-end operators.

*4.2. The perceived value and use of accident investigation reports*

After the informants explained how they not only acquired information from accident reports, but also other sources (RQ1), they were asked how they used this information (RQ2) and perceived its value as sharp-end operators in the maritime domain (RQ3). The deck officers reported that the information they found most interesting was related to Human Factors, ship handling operations and similar areas associated most closely to their specific sector of work, work environment and tasks of their employment. One stated: *"I'm a navigator myself and have my duties on the bridge, I have most interest in what has to do with the bridge organization"* (Informant 12). Another explained: *"It is reports that… that are relatable to the operations our vessel conducts"* (Informant 13). It is evident that the reports are viewed as an opportunity to reflect upon lessons learned and put in the context of their own work.

Several of the deck officers described that the accident reports are not always easily understandable. Informants mentioned what can be described as inherent barriers in accident reports and messaging, which may not cover or highlight direct and implementable information to their work tasks. These experiences were reported by informants and may be a discouragement for sharp-end operators to pursue, read or find relevance in accident investigation outcomes and accident reports. Three informants discussed that they find the official accident reports written in a language that is too academic and formal, and thus perceived as cumbersome to read to extract relevant information from. One of these informants described how inaccessibly academic language makes them hard to use: *"If they are too comprehensive, it's not being read. Similarly, if it is written in heavy academic language it's also not read"* (Informant 18).

This was echoed by informants wishing that accident takeaways were more effectively utilized and made relevant to sharp-end operators, whether through safety meetings or active training exercises. Many informants discussed the failure to connect learning outcomes from accidents to relevant implementation for their work, with one informant noting: *"They* [accident reports] *are of good quality… but Ím not sure if they are of good quality related to understanding them, or if they are of good quality in that they describe what… It depends what you mean by good quality. When it comes to good quality in terms of using them, and learning from them; then I think they could have been better. Things could have been explained in a better way. Things could have been written in a way that would make it easier for people to use, if they are to learn anything from it. But quality… it's a report. If they have good quality or not is hard for me to answer, because it depends what you wish to use it for"* (Informant 2).

The analysis revealed that informants perceived learning from accidents to have an important role in maintaining safety in the maritime industry. However, few of the interviewed deck officers actually seek out and read accident reports on their own initiative or access them, even if they acknowledge the learning potential in doing so. The connection between reading accident reports for sharp-end operators and their connection to improving safety, accident prevention and learning was illustrated by one informant: *"I think absolutely that they are a good tool. Not just for people working on board but also to the ship owning company. If it was not for reports, we would not have any basis for anything. We would not learn from anyone's mistakes. So I think they are a very good tool"* (Informant 8). Several informants pointed to how they believe reviewing official accident reports provides them with insights that can help make them aware and prepare for things they may not have thought about otherwise, with one remarking: *"It is important to read, so that you can take some precautions you normally would not have thought about"* (Informant 7). Informants noted that the reports provide an opportunity to reflect upon the lessons learned and put it in the context of their own work. One described: *"Ít's clear that when an accident happens on one boat, such as the* [SHIP NAME REMOVED], *there are similarities to the work we do. We cań't then make fools of ourselves by going into bad weather and get low levels of lubricant oil, so that everything shuts down. With such accidents, one must go into one self"* (Informant 3). Similarly, another informant noted: *"Therés no point to just read them; you must reflect… have the opportunity to reflect… in a way. Well, I think the most important is to discuss them afterward. That you first read it, for then to discuss it. To get a reflection upon it, in a way. Then, Ím thinking that you will develop an understanding. An understanding that can help you in your daily work."*

The data demonstrates that information about accidents that is utilized by the informants comes from differing sources and presented in differing formats, whilst formal accident reports are seldom used or sought out. Although the informants consider the accident investigation process, outcomes and formal report valuable mechanisms for upholding and improving safety in the maritime domain and their profession, they paradoxically avoid the original source of information: the accident report itself. Rather, informants rely on other sources and entities to summarize and/or transform accident learnings into what they report and perceive as relatively more efficient and targeted formats that extract and present information more aligned with their profession and work tasks.

## 5. Discussion

The empirical data of this research sheds light on how deck officers acquire, use and perceive the value of accident reports for their work. The findings reveal that few informants access and use original accident reports, even if they consider the reports valuable for maintaining safe work practice. The interviews indicate that the primary sources of accident information are transformed and summarized narratives of the accidents, as told by the officer's employers, colleagues and media.

A comparably stronger connection to accident report information was found when communicated from their shipping company than from the original accident reports published by investigative bodies. Most of the informants said that they receive summaries of accidents predominantly in the form of written summaries, such as digital newsletters or as information presented and discussed in mandatory safety meetings. This implies that the shipping company adapts the original accident report, or internal reports, to a specific audience by extracting, summarizing and transforming original source information before presenting the story to its employees. Thus, at some level within their company a selection process is carried out where accidents, and accident information, are chosen, treated, reduced and potentially interpreted in order to compile and present shorter summaries prior to reaching the sharp-end operators at the individual level. It appears that these processed versions of the reports are more accessible, and thus more frequently used by the deck officers. One weakness of this information flow is that the original content of official reports does not necessarily reach sharp-end operators and that the retold, informal stories may be subject to errors, omissions or biases.

Most of the deck officers did not distinguish between formal accident reports issued by investigation bodies and reports issued by a shipping company. The informants were most interested in the narrative of an accident and reported that the most interesting content was specifically related to their own work and work sector (e.g. specific ship-type, geographical area, operation, work tasks). Furthermore, the deck officers who reported seeking out accident information on their own initiative and intrinsic interests predominantly focused on cases they found personally relatable with their specific work. The preference towards narratives within the deck officer's specific sub-sectors of the maritime domain (as well as their specific sub-cultures) is an important aspect of being able to relate to a larger community (Dailey & Browning, 2014; Gherardi, 2017). The results indicate that accident reports, although valued by the deck officers, were generally avoided in favour of sources which were driven by approaches that presented content with a greater focus on storytelling and narrative-building, aligning with Rae (2016) and Vepsäläinen & Lappalainen (2010). In developing more effective shared narratives of past experiences sharp-end operators can improve their sensemaking (Weick, 1993). Future performance can be improved through developing prospective sensemaking (Dwyer et al., 2021) where focused, simplified stories of past incidents are used as tools to build sensemaking skills (Boudes & Laroche, 2009). Furthermore, only a few of the informants mentioned technical knowledge as an output of interest from accident reports, instead favouring what can be labelled as more human factors-related issues, such as non-technical skills. Human factors can also be understood as an essential part of "seamanship" and the "soft skills" of work ethics, obligations to fellow seafarers, the ability to make sound judgements and what is considered safe work practice in a community of practice (Kongsvik et al., 2020). This suggests that the sharp-end operators tend to favor content that is relatable to them and their professional identity and culture, as described by Brown & Duguid (2000). Creating a culture where seafarers are encouraged to identify their own training needs can lead to a more positive learning environment and more effective training outcomes (Tang & Sampson, 2018).

The quest for information and professional scrutiny is driven by what they regard as applicable to their lifeworld, as described by Goodwin (1994). What is relevant knowledge depends on both the maritime sub-sector, but also what characterizes the ship and sub-culture where the deck officers work. For example, if one works specifically within the cruise industry as a deck officer the characteristics of one's work and work environment can vary widely. One may be an officer on a small-sized luxury ship with state-of-the-art technology, only a handful of passengers, a relatively small crew/co-worker cohort and limited operational area. In contrast, with the same professional credentials and working within the same sub-sector of the maritime domain allows one to work on mega-cruise liners with more than 6000 passengers, a larger crew/co-worker cohort, potentially differing operational technologies, operating environments and schedules. These types of differences and

details in one's profession plays a role in what Schön (1995) coined "reflective practice", highlighting that experience alone does not necessarily lead to learning but that deliberate reflection on what drives one's own professional practice is essential. Thus, the specific characteristics of an accident, and subsequent accident report, may encourage or inhibit interest from sharp-end operators.

Although the maritime domain has a history of developing policy from accidents reactively rather than taking a more proactive approach (Psaraftis, 2002; Schröder-Hinrichs et al., 2013), there is a value in learning from adverse events in order to prevent future occurrences (CIEHF, 2020). In shipping the Titanic disaster of 1912 arguably remains the industry's most famous accident. The learning outcomes led to sweeping changes in safety standards and codification for the industry which contributed greatly to system safety advancements that are still relevant and implemented today (AGCS, 2012). However, learning from previous events, and training for known dangers, can also develop cognitive biases and impact decision making in workers (Gaba et al., 2001; Park et al., 2014). If sharp-end operators of safety–critical systems are trained repeatedly on specific scenarios, contexts and information, they may be more biased and less resilient to adapt to new or unforeseen events which past-events and training did not prepare them for. Thus, the biases potentially introduced to individuals and organizations that learn from and utilize accident reports and recommendations must be understood and applied as part of a larger program for learning and safety improvement. This is particularly relevant as the rapid introduction of new technologies, higher levels of automation and autonomy of system functions create systems, operations and chains of events lead to unintended consequences that have never occurred previously. Pomeroy & Earthy (2017) note that due to these technology-related advancements the maritime industry has to look to more forward-facing approaches of "*learning without the incidents*" through synthetic lessons of hypothetical or simulated occurrences.

Furthermore, the accident investigations themselves and associated findings may have inherent deficiencies introduced within their methodologies that affect the quality and usefulness of an investigation as an opportunity for learning from adverse events (CIEHF, 2020). In particularly, what Dekker (2014a) labels the "old view" of accident causation, where human error is seen as a cause of failure, rather than a deeper symptom assigns blame, rather than addressing root issues. Thus, the quality of the learning opportunities for front-line operators is dependent upon the quality of proceeding accident investigations, including the reporting, access and utilization of information. This is a threat to both the independent, public accident investigation processes, but also other accident or incident investigations.

Our results support previous findings (e.g. Johnson, 2002; Pomeroy & Earthy; Vepsäläinen & Lappalainen, 2010) that found the way accident investigation reports are written, including the format, content and language are barriers for engaging sharp-end operators. Johnson (2002) noted that barriers to learning from accident reports may be due to the length and inaccessible language used, as also indicated by several of our informant's comments on the academic nature of the report content, with one explicitly stating the type of language used causes him not to read such reports. Furthermore, online accident databases, for which accident reports are catalogued, contribute to long-term and continuous improvement to organizational performance (Cooke & Rohleder, 2006), however require more user-friendly interfaces and functions (ESReDA, 2015). This may be a contributing factor of our informants reporting their use of differing media channels as sources for information on accidents, which may or may not be followed with further inquiry by the individual. As noted by Lindberg & Hansson (2006), the dissemination stage is regarded to be the weak link of the CHAIN model. Obtaining information surrounding accidents through media might be an observation of deficiencies in dissemination of accident outcomes. However, our informants indirectly described a culture norm where the preferred artefact and expectation is not to utilize an original accident report, but rather to receive or seek out summary information in varying forms. It

may be argued that removing the aforementioned barriers may encourage higher utilization of original accident reports and accident investigation information by sharp-end operators in the maritime domain, and that may contribute to more effective knowledge transfer and learning. However, this must be caveated with the assumption that accident investigations and their outputs are of sufficient quality and/or usefulness for sharp-end operators). This remains unanswered and outside the scope of this current research. Regardless, an important takeaway from this research is that original accident reports are seldom utilized by the informants interviewed, and by extension, seldom utilized by their employers in communicating accident-related information to their sharp-end operators.

Although accident investigation reports are aimed to be tools for learning (Dekker, 2014b) and public accident investigation bodies state that a primary principle of accident investigations is to transmit learning outcomes and recommendations (IMO, 2008; MAIIF, 2019; NSIA, 2020; TSBC, 2020), there is a disconnect for sharp-end operators. Further attention must be placed on the intended audience for an investigation and it's reports, and give more control and ownership to employees (Sanne, 2008). In order to better close the gap and facilitate knowledge transfer between accident outcome learnings and sharp-end operators a more storytelling-driven approach is needed. Our informants described that they want direct links and implementable learnings from accident investigations to their specific jobs, work tasks, working environment and shipping sector. This goes beyond "lessons learned" or even generalized practitioner summaries to more specific messaging, language and relatable content for differing types of seafarers and sharp-end operators.

### 5.1. Methodological discussion & limitations

It must be noted that the design and execution of this research has limitations which may have influenced the data collected, interpretation and conclusions drawn. The semi-structured interview format allowed for more descriptive responses and dialogue, whilst creating opportunities for both the informant and interviewer to clarify, rephrase and follow-up on questions and themes (Dörnyei, 2007). This was a valuable characteristic for the explorative nature of the study and the confusion in terminology and interchangeability of the term "report" informants used when referring to differing sources and types of accident investigation information. The informant sample recruited were Norwegian seafarers who were licensed deck officers and held differing positions and work experience with differing companies, industry sectors and types of ships. Although, this represents diversity within the informant sample, the specialty of their profession, educational background, nationality, age range and language created a relatively homogenous sample. As the scope of this research was narrow (i.e. sharp-end operators in the maritime domain's experiences and perspectives on accident reports) thematic data saturation occurred with the informant responses (Saunders et al., 2018).

Informant dialogue was transcribed and then translated from Norwegian, the original interview language, to English, as reported within this paper. Every effort was made to provide accurate language translation and keep original meaning and subtleties of informant responses intact in translation. It must be noted that due to the homogeneity of the informant sample: all eighteen informants being Norwegian nautical officers, of relatively young age (20–25 years of age) and relatively short durations working at sea (work experience of up to eight years). These aspects are not a weakness in the research design or findings, but the impact on results and their generalizability across differing populations and domains needs to be considered. Research on differing profiles of nautical officers and maritime workers may elicit differing findings.

The semi-structured individual interview format (see Appendix A) was implemented with informants in differing settings: in-person (n=3) and via telephone (n=15). These two forms of interviews may have introduced differing effects on informants and their responses. In the

case of face-to-face interviews, the interviewer was physically present, potentially introducing subconscious or unintended influencing factors, such as body language or interview style, which would not have necessarily existed in a telephone interview format, introducing potential response biases in informant responses.

## 6. Conclusions

How deck officers use maritime accident investigation information is multifaceted. Our results show that the officers access and use accident investigation information in various ways, through various channels and to varying degrees. Results indicate a relatively low rate of utilization of the original accident reports, while their employers (i.e. the informant's shipping company/ship owning entity) were reported to play a significant role in the dissemination of accident-related information to the sharp-end operators. What is eventually received by the officers in predominantly summarized and transformed formats of the original. The deck officers detailed barriers in format and scope of accident reports that limited their interest in them as a learning tool, favouring alternative sources, formats and transformed information which focuses on storytelling and a narrative-driven style more relatable to their specific work practices and backgrounds.

Differing formats from the traditional accident report should also be considered and tested in order to reduce barriers and facilitate knowledge transfer to sharp-end operators. Alternative platforms and methods should be explored to facilitate increased self-reflection and discussion, for example, through text, presentations, video, simulation, recreations, role play, images, scenario building and improvisation, interactive debate or other mediums, or combination of mediums. This research finds an inconsistent and underutilized potential of accident investigation outcomes for maritime deck officers. Our findings point towards the need to create more specific messaging and focus on sharp-end operators in order to transform broad or generic lessons learned from accidents into implementable practices and applicable knowledge in operations, thus strengthening multilevel learning between the individual and system level safety.

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## Authorship roles

S.C.M. led the writing and revisions of the manuscript, and contributed to the experimental design and data analysis. A.M.W. contributed to the writing and editing of the manuscript, in particularly the theoretical framework and data analysis. J.A. conceived the original idea, collected and analysed data, and contributed to the writing of the manuscript.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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