

Use of checklists, and potential of the introduction of digital checklists onboard vessels



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Summary

With this Bachelor thesis, we aim to examine the crews' attitude towards checklists, study how checklists are used today, and analyze if there is a potential in implementing digital checklists onboard vessels. The problem to be addressed is the following:

Use of checklists, and potential of the introduction of digital checklists onboard vessels.

The study focuses on history of checklists in maritime and other industries, digitalization and organizational change as a theoretical framework. This will illuminate the chosen research questions with a focus on how digital checklists are used today, and the potential of implementing digital checklists. Prior to the data collection process, we got the opportunity to work at DNVGL's innovation team in summer 2020. Being a part of an interdisciplinary team, we developed an immense understanding of today's challenges within the maritime industry's safety risk perspective.

Data collected shows different attitude towards checklists in the maritime industry, and a disagreement regarding whether checklists are used as a working tool or as a part of the reporting process. Further the data show that the term of digitalization is misunderstood, and that the difference between platforms providing digital checklists today can be distinguished with, digitized and digitalized checklists.

We believe that digitalization of the checklists in the maritime industry is a compelling topic, nevertheless we are skeptical for digitizing of checklists onboard vessels and are wondering if it really affects the attitude towards checklists, or if it just makes checklists more convenient to complete.

Sammendrag

Dette studiet ser nærmere på mannskapets holdninger til sjekklister, og hvordan disse brukes ombord på fartøy i den maritime bransjen i dag. I sammenheng med dette ønsker vi å se på om det er potensiale for digitalisering av sjekklister, og hvordan dette vil påvirke den operasjonelle prosessen ombord. Med dette er følgende problemstilling valgt:

Bruk av sjekklister i dag, samt potensiale ved implementering av digitale sjekklister

Dette studiet bruker sjekklstens historie innenfor ulike bransjer, digitalisering og endring av organisasjoner som teoretisk grunnlag. Dette vil videre hjelpe til å svare på utformede forskningsspørsmål om hvordan sjekklister brukes i dag og videre se på potensiale for digitalisering av sjekklister. I forkant av innsamlingsprosessen fikk vi mulighet til å jobbe i DNV GL's innovasjons avdeling sommeren 2020. Det å være en del av et tverrfaglig team gjorde at vi fikk økt innsikt og forståelse for dagens problemstillinger innenfor skipsfarten, sett med et sikkerhetsperspektiv.

Innsamlet data under dette studiet belyste forskjeller mellom holdninger til sjekklister i dag, og en tydelig uenighet vedrørende sjekklstens formål. Videre viser innsamlet data en misforståelse av begrepet "digitalisering", og at dagens utviklere av digitale sjekklister enten kan kategoriseres som digitiserte eller digitaliserte sjekklister.

Vi tror ser på det som interessant å digitalisere sjekklister i den maritime sektoren, derimot er vi noe skeptisk til dagens rederier som velger å digitisere. Vi stiller spørsmålstegn til om slike løsninger faktisk kan være med på å endre holdninger til gjennomførelse av sjekklister, eller om denne digitiseringen kun gjør gjennomførelsen av sjekklistene mer lettvtint.

Nomenclature

CHECKLIST- A list of items required, to be done, or considered, used as a reminder.

DNV GL- Det Norske Veritas (Norway) and Germanischer Lloyd (Germany).

HSEQ- Health, Safety, Environment & Quality

IMO- International Maritime Organization

ISM- International Management Code for the Safe Operation of Ships and Pollution Prevention

ISPS- International Ship and Port Facilities Security Code

IMDG- International Maritime Dangerous Goods Code

MARPOL- International Convention for the Prevention of Pollution from Ships

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

SMS- Safety Management System

SOLAS- International Convention for the Safety of Life at Sea

DPA- Designated Person Ashore (according to the ISM Code)

TEU- Twenty-foot equivalent unit

Report- To report is to pass on information to others. A report can be oral or written or both.

Documentation- To document means to make visible, substantiate or justify something.

Through documentation, we can bring out what we have observed and performed in the work.

Sometimes we also bring out what we have not done. There are several ways to document.

IoT- Internet of Things

Digitization- Converting data, documents and processes from analogue to digital.

Digitalization- Transforming business models by leveraging digital technologies, ultimately resulting in opportunities for efficiencies and increased revenue.

Introduction

The maritime industry is continually under development, with a focus on more modern and efficient solutions. Despite massive technological growth in recent years, checklists exist in paper format, archived and stored in folders onboard, or laminated and hanged on walls/doors onboard vessels.

Shipping companies constantly comply with a bunch of regulations in the maritime industry such as The International Safety Management (ISM) Code, The International Ship and Port Facility Security (ISPS) Code, The International Maritime Dangerous Goods (IMDG) Code, The International Convention for the Prevention of Pollution from Ships (MARPOL), The International Convention for the Safety of Life at Sea, 1974 (SOLAS), International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) and many other classification requirements, conventions, and codes (Ship safety management system - ShipManager QHSE, 2020). The International Maritime Organization (IMO) have amended a management code called ISM Code, and for a shipping company to be compliant it must establish a Safety Management System (SMS) to ensure safe operations onboard vessels. Moreover, to comply with The ISM Code shipping companies should implement procedures and checklists for safe operation onboard vessels. Maritime industry is under development, and we can see that more shipping companies implement digital solutions into their daily operations, including SMS and checklists, as a part of SMS.

As digitalization of checklists is a relatively new concept in maritime industry, we considered such research question rather compelling. The topic of this study was chosen to be the following:

Use of checklists, and potential of the introduction of digital checklists onboard vessels.

This research topic will be analysed with the help of the qualitative and quantitative research methods, based on depth interviews, surveys, and observations. The thesis consists of an introduction, literature review, including theoretical framework, research methods, results of the study, discussion, conclusion, and recommendations for further work.

In the first chapter of the thesis, the selection of theory relevant to the topic will be represented. Literature and articles that create the theoretical foundation for digital checklists' topic and shipping companies' procedures will be highlighted. Furthermore, methodological choices related to data collection, data analysis, and ethical considerations will be explained. Then the results of the study will be presented. In the discussion chapter, we will consider how digital checklists can potentially impact the operational process onboard. Finally, we will discuss the possibilities, implications, and suggestions for further research. The last part of the thesis will be methodological considerations and conclusion.

1 Background

Today we can read about different industries that are using checklists, both analogue and digital ones. The health sector, industry construction uses checklists to ensure that the various procedures are being followed, ensure safe work performance, and document procedures. Furthermore, checklists are considered an essential error management tool and reduce the risk of human beings' common mistakes (Hales and Pronovost, 2006).

The shipping industry uses checklists to ensure safe operation on board and document followed procedures. According to Knudsen (2009), efforts to reduce human errors in the shipping industry have increased the number of standards, rules, control, and administrative work, such as procedures and checklists onboard. ISM code requires shipping companies to have checklists that correspond to the vessel's procedures and provides guidelines on how to apply checklists with the following wording: *"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"* (ISM Code: Latest update, 2010, para. 4). In other words, the shipping companies must implement, support, and continuously improve internal SMS, including procedures, checklists, and instructions. It shows how many regulations and compliance document both shore organisations and vessels should provide to be compliant.

IMO regulations and ISM code will be presented in the next chapter. Moreover, this thesis's background establishes the research's context, essential for understanding the study's central aspect. This chapter shall establish a baseline and explain why the topic of the study was chosen.

1.1 Checklists

Checklists can help avoid inaccuracies and simplify complicated tasks or operations (Collins, 2018). Gawande, in his book “The Checklist Manifesto” (2009), explains how checklists can reduce human errors and minimize adverse effects within complicated professions, especially healthcare (Gawande, 2009). Additionally, researcher states that checklists can reduce human errors and minimize adverse effects within complicated operations and procedures, especially in the healthcare industry (Gawande, 2009). The distinctions between two types of errors is mentioned by Gawande (2009) as essential in understating the reason for inaccuracies. These are errors of incompetence (one do not apply knowledge correctly) and errors of ignorance (one do not know enough). The researcher explains that checklists can diminish and prevent inaccuracies by focusing on two fundamental issues. The first issue addresses the topic of our memory capacity and attention to detail. According to Gawande (2009), our memory capacity is not reliable. The second issue is the tendency to skip steps, even though we remember them. To summarize, a checklist is defined as one work-related tool to reduce mistakes related to limitations within human memory.

1.2 IMO regulations and ISM code

IMO is a specialized agency responsible for developing and maintaining the regulatory framework for security and safety at sea (Aeromarine, 2020). IMOs scope is to create, implement, and maintain standards for the international shipping industry in the field of safety, environment, legal matters, and maritime security (IMO, 2008). The fundamental IMOs conventions that are relevant for this study are SOLAS (1974), MARPOL (1973), STWS (IMO, 2019).

After a series of severe shipping industry accidents in the 1980s, IMO has adopted new regulatory Guidelines on Management for the Safe Operation of Ships for Pollution Prevention. These guidelines became the base for the ISM Code (IMO, 2020). ISM code creates a framework of general principles and requires all shipping companies to introduce the SMS (Regulation to ISM code, 2015). In general, SMS shall demonstrate and document how each shipping company vessel meets the mandatory general safety requirements. Furthermore, SMS is based on operations' risk

assessments and document descriptions on how safety, maintenance, and operation are managed onboard vessels (Australian government, 2020).

Even though SMS should contain several requirements such as instructions and procedures to ensure safe operation, the ISM Code itself does not mention which format or content of procedures, instructions, or checklists (ISM Code: Latest Updates, 2019). Furthermore, the ISM Code does not establish any regulations about how checklists should be used in practice, neither if shipping companies must use the digital or analogue form (Justis- og politidepartementet, 2000). In other words, such regulations gave companies a prominent level of freedom on the format of procedures and checklists and resulted in a variety of checklist formats. For example, some shipping companies still use checklists in paper format, which means that crew onboard prints and signs checklists. Other shipping companies do not expect crew onboard vessels to fill up checklists for each operation. In such a case, crew members print out checklists and laminate them for further reuse. Therewithal, more shipping companies started to implement electronic checklists, both digitized and digitalized. Consequently, various providers of digital SMS, procedures, and checklists can be found on the market, and some of these providers will be presented in the next chapter. Later, the theoretical framework of the study and difference between digitized and digitalized work processes will be illustrated.


1.3 Providers of digital checklists


Nowadays, many various software solutions for transforming procedures, checklists, and processes into the digital version can be found in the maritime industry. These software solutions can potentially facilitate information collection from vessels and provide a structured system for synchronizing relevant documents between vessels and shore organizations (UniSea, 2020). Most of them offer a possibility to create a digital version of work processes in digitized checklists, procedures, templates (Zegeba, 2020). In other words, digital solutions are built for easy transformation of documentation work into a digital format and are designed for data capture both online and offline. Likewise, they provide the possibility to generate reports and present data for analysis immediately. There is plenty of different providers, such as UniSea, Zegeba, Ccom, Maranics, and others. In this study, we have selected a few of these, and analysed their characteristics. During our summer job at DNV GL, we got familiar providers of digital SMS and checklists. In the conversations with fifty HSEQ managers, UniSea was mentioned as the most known digital solution for checklists. Maranics is closely collaborating with DNV GL across many projects to increase quality of digital checklists in maritime industry. Therefore, these providers were chosen to be presented in this study.


UniSea solution is an integrated software solution for HSEQ and operational support for shipping and offshore companies. Through UniSea “Forms and Checklists,” shipping and offshore companies get the opportunity to transform paper documentation into a digital format. By using the "template builder", shore organization and crew can build all necessary types of forms and checklists (UniSea, 2020).

UniSea has also developed an offline mode, that gives the vessel access to all documents even if they lose connection. When ships operate in an area without internet access, all changes that have been done during offline mode will automatically be updated as soon as the vessel regains access to the internet (UniSea, 2020). Offline updates solution allows users to keep track and control the different versions of data files. In such a way, the shipping company can ensure that the crew is updated o the latest changes of internal requirements.

LOG UNISEA TENDER ⌵

 UNISEA CERTIFICATES +

 UNIVU BUSINESS MANAGER +

 **UNISEA FORMS & CHECKLISTS** -

Forms & Checklists is a versatile and powerful application to aid with the transition from paper to digital task documentation.

Create all types of forms and checklists with the template builder. A Template can be anything from a basic form to complex checklists used during Dynamic Positioning. The user role regulates the access and distribution of templates.

The data collected using Forms & Checklists are not available for analysis or SQLite export.

Key features

- Create all types of forms and checklists
- Limit access and distribution of templates by roles.
- Easy to use

Schedule a demo




Figure 1 UniSea module "Checklists and forms". (Downloaded from Unisea.com)

Maranics is another Scandinavian provider of digital checklists that originated from the maritime and offshore industry and was established as an independent Company in 2017. Their goal is to provide operational industries with the next generation of digital flows where IoT, increasing information, and fast pace creates new demand for human input (Maranics, 2020).

Maranics delivers several solutions to the market, such as digitalization of work processes, focusing on capturing data while doing the processes (Maranics, 2020). Moreover, Maranics allows customers to create checklist templates, create integrations with other systems using API integrations, and share data across all applications. Since 2018, Maranics has been used onboard major cruise liners and is now getting implemented in different use cases (Maranics, 2020).

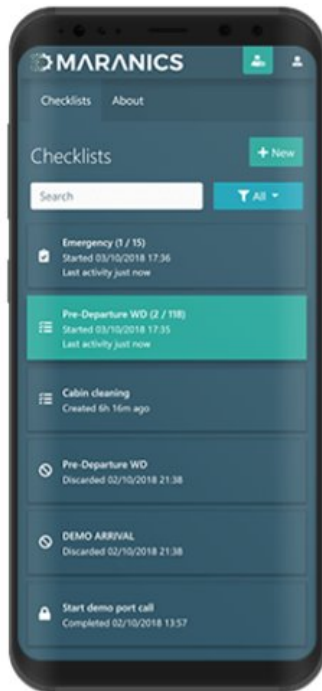


Figure 2: Example of digital checklists application interface from Maranics. (Downloaded from Maranics.com)

To summarize, the shipping industry uses checklists to ensure safe operation on board and document followed procedures. These days, shipping companies have a prominent freedom in the format and content of procedures and checklists, which resulted in various checklists formats existing in the maritime industry. Providers of digital checklists deliver various digital solutions for shipping companies, such as digital, which means that shipping companies are not obliged by ISM regulations to follow or use specific digital checklists' specific formats or solutions. The next chapter will describe the research questions and limitations taken into consideration.

2 Research questions

This Bachelor thesis's objective is to evaluate checklists' usage today and investigate the possibilities of implementing digital checklists in the maritime industry. The problem to be addressed is the following: *Use of checklists, and potential of the introduction of digital checklists onboard vessels.*

This acted as a basis for the following research questions that would facilitate the research process, help to get a better overview as well as illuminate the topic of this study:

1. What role do checklists play in the operational process onboard?
2. How are analogue and digital checklists used today?
3. What is the crews' attitude towards checklists today? Are checklists perceived as a working tool or as a part of the reporting process?

The first research question addresses what *role checklists play in the operational process onboard*. It will improve the comprehension of factors that affect both analogue and digital checklists' usage and help explore checklists' role in the operational process. The second research question, "*How are analogue and digital checklists used today?*" would allow us to understand how checklists are used today. Finally, the third question will explain the crew's attitude towards checklists, analogue, and digital ones.

3 Limitations

We applied our specialization in "Shipping Management" as the theoretical basis for this bachelor thesis. Several subjects could help us illuminate the digital checklists' topic in the maritime industry from different points. For example, checklists could be explored from a safety risk perspective where theories, methods, and interpretations within the risk management subject might be used. Checklists are directly connected to the crew's attitude towards safe operation and organizational culture. Due to the fact that organizational culture and risk management are relatively extensive topics, we considered it difficult to analyze checklists from these perspectives.

This study focuses merely on crews' attitude towards checklists, the format of the checklists today, the role of checklists in the operational process, and the potential of transforming analogue checklists into digital ones. The study defines operational processes as routines and daily operations completed by the crew members onboard vessels. In other words, the focus is on those operational processes connected to checklists on the inter-organizational level and do not have analyzed technical aspect and effect of digital checklists on the technical or navigational side of the operation. This thesis does not examine whether checklists facilitate or weaken safety-risk onboard vessels, neither design or content of checklists. As mentioned before, the thesis merely focuses on the operational process onboard, and the role checklists play in it. Ultimately, this bachelor thesis was written during the autumn semester. Due to the limited framework for the thesis's scope and time limitations, it was vitally important to choose an interesting topic that could match our educational background and knowledge.

4 Theory

In this chapter, the current theoretical framework for the research topic will be presented. The defined theoretical framework is a basis for future investigations and discussion around digital checklists' topics and their effect onboard vessels' operational processes.

Firstly, the theory chapter will address the history and background behind checklists' development in aviation and maritime industries. A better understanding of checklists' scope will create a framework for further discussion about the crews' comprehension and attitude towards checklists.

Digitalization, digitization, and digital transformation are on everyone's lips these days, but what is the difference between "to digitize" and "to digitalize" checklists onboard? Secondly, the theoretical background on the difference between digitalization and digitization will be presented in this chapter. It will provide a framework for future discussion about the effect of "digitized" and "digitalized" checklists onboard operational processes. Moreover, current theories about digital tools as methods of coordination and control will be introduced. Such approaches will provide a reason to discuss digital checklists' role in the operational process as a control/reporting tool. Other theories related to organizational changes will support the discussion about the seamen's reaction to the transformation of the established work process and the challenges that the shipping company should be aware of by changing the work process. Furthermore, reference is made to the theoretical background of checklists in the maritime industry. The established theoretical framework will support the discussion chapter and help to reflect the result of the collected data.

4.1 Checklists in the aviation industry

The aviation industry contributed considerably to the development and introduction of checklists. According to a study completed by Øhrn and Hedlund (2014), digital checklists have been used in industry since the 1980s. Experiments held in the 1980s, in Rouse and Rouse, indicated that fewer errors were made with digital checklists' application. Later attention around digital checklists and their potential increased. Nowadays, checklists in the aviation industry are mostly digital (Øhrn and Hedlund, 2014).

According to (Degani and Wiener, 1990) electronic checklist in aviation usually includes a display and pointer list. When a crew performs necessary tasks in the checklist, the colour changes, this interface solution gives pilots the possibility to better overview completed tasks (Degani and Wiener, 1990). These and other features can differ from various manufacturers and software providers of the checklists (Øhrn and Hedlund, 2014).

In the aviation industry, checklists are performed both before and after take-off and landing processes, and a so-called *read-do* method is used. Such a method ensures that the cockpit officers complete each item before moving to the next one on the list (Stoller, 2018). Checklists are always performed between two officers on watch, while the maritime industry has another approach of completing the checklists. The history, background, and scope of the checklists in the maritime industry will be introduced in the next chapter.

4.2 Checklists in the maritime industry

Focus on onboard safety vessels started around the 1980s. Many accidents occurred, and the accident was often said to be caused by human error. Therefore, the whole industry was obliged to have a better safety focus (Vandenborn, 2018).

Checklists were introduced in the shipping industry to promote safe operations on board and reduce accidents. Per definition checklist is *"a formal list used to identify, schedule, compare or verify a group of elements or... used as a visual or oral aid that enables the user to overcome the limitations of short-term human memory"* (Hales and Pronovost, 2006, page 231). Objectives of the checklists can be following standardization and regulation of the process, increase and improvement of memory recall, providing a framework for evaluations, etc. (Hales and Pronovost, 2006).

Numerous attempts to reduce human errors and ensure safe working practices on board vessels triggered various regulations, administrative works, and several types of assessments, which resulted in seaman's resistance toward checklists and procedures. Furthermore, Knudsen (2009) states that increasing proceduralisation and the fact that seamen are obliged to follow checklists and procedures to complete operational processes is perceived as a sign of untrust from shore organization. Seamen feel misunderstood, underestimated, and undervalued by "non-seafarers" from shore organizations (Knudsen, 2009). Since representants write regulations from shore organization, seamen lack ownership over regulations, procedures, and checklists they are subject to, which results in resistance from seamen's side. Another critical factor influencing the seaman's attitude towards the checklists is that the vessel's type influences working environment and identities, segment vessels operating in, shipping company, culture, and many other factors (Knudsen, 2009).

However, according to recent studies, there is a tendency that written procedures and that checklists are not perceived by seafarers as a tool to operate more safely and reduce human errors. On the contrary, common sense, professional knowledge, and experience are commonly prioritized by the concept of "seamanship" (Knudsen, 2009). Preventive safety measures related to "paperwork," such as filling out work permits or checklists are perceived as bureaucratic, pointless, and even counteracting safety (Knudsen, 2009).

To summarize, checklists in the maritime industry exist to ensure and promote safe operation onboard vessels. According to recent studies, seafarers show a decent level of resistance towards checklists, but can digitalization change the situation? The next theoretical chapter will analyze digitalization in detail.

4.3 What is digitalization?

Digitalization is a widely used word in the maritime industry. Smart ships are described by concepts like automation, electrical and propulsion systems, sensors, robotic, and big data analytics (Smart ship technology, 2016). Even though ships collect data from different sensors today, there seems to be an issue in processing, analyzing, and utilizing the recorded operational data (Smart ship technology, 2016). Intelligent ships will make more rapid operating decisions by analyzing real-time data and providing real-time information regarding the equipment's condition onboard. This data collection type can lead to more optimized maintenance, operational planning, better performance, and safety focus (Smart ship technology, 2016). Moreover, the development of technology in the industry has helped to increase the tempo and complexity of the informational exchange between ship-shore (Aaslestad, Lind, and Brusdal, 2017). As organizations grow, technological development, organizational culture, and competitiveness limit information sharing (Stitch, 2020).

Connectivity is one of the basic functions that is an essential characteristic of digitalization. This is essential because it gives different actors the possibility to stay constantly "connected" via the internet. Moreover, data from sensors, humans, and machines are expected to be available anywhere and anytime. Andersen, Bjørnset, and Rogstad (2019) consider connectivity crucial to transfer data from the ship to land-based organizations. Thus, connectivity will affect both the ship's operation and the work of land-based stakeholders (Andersen, Bjørnset, and Rogstad, 2019).

According to Låg, Vartdal, and Knudsen (2015), connectivity development will diminish current obstacles and enable many new applications for maritime users. With the help of "connectivity," actors in the maritime industry will get the opportunity to identify possibilities for further

improvements based on vessels' operational data, which means that operational data will be forwarded to shore in real-time. Automatic reporting applications will replace manual, handwritten reports, which will result into more efficient operational communication between shore and vessel (Låg, Vartdal and Knudsen, 2015). Further, authors state that challenges connected to the connectivity can be expected in the nearest future. As connectivity will empower the development of new applications, new requirements on the *"availability and reliability of the communication systems used for the new applications shall be established to support the systems' reliability"* (Låg, Vartdal and Knudsen, 2015, p.34).

A report from FAFO, an independent social science research foundation about maritime competence in a digital future, discusses digitalization progress in the maritime industry. The starting point of the report is Digital21's work around the topic of digitalization. Digital21 is a committee established in 2017 by the Norwegian government, intending to provide industries with advice and recommendations on digitization (Andersen, Bjørnset and Rogstad, 2019). Digital21 also presents a definition of the term digitalization: *"Digitalisation is about using digital enabling technologies to improve, innovate, and create something new"* (Digital21, 2017, p. 34). Digital solutions can provide efficiency and cost-reducing gains; however, they also entail organizational, management, and security challenges (Digital 21, 2017). The report affirms that Digital21 declares digitalization as crucial for the Norwegian maritime industry. At the same time report states that Digital21 does not provide a clear answer on how digitalization will affect the industry, neither on how the development can challenge stakeholders in the sector (Andersen, Bjørnset and Rogstad, 2019).

However, seafarers should be prepared to the changes in the operational process digitalization can bring, but shore organizations as well. Thus, the discussion about difference between digitization and digitalization of the process is valuable in this context. In the next chapter, we would like to analyse organizational changes and reflect on challenges organizations can face with introducing digital processes. In the next chapter we would like to analyze more in detail term digitalization, its influence on processes, and the deeper difference between digitalization and digitization.

4.4 Difference between digitization and digitalization

Multitudes of definitions across different industries resulted in the misunderstanding around terms digitization and digitalization. Store Norske Leksikon defines digitalization as: "*Digitization is to facilitate the generation of digital information as well as the handling and utilization of the information using information technology*" (SNL, 2019, section 1). On the contrary, Gartner dictionary defines digitalization as use of digital technologies to change a business model, provide new income streams, and increase opportunities for new value creations (Gartner, 2020).

There is analytical value in unequivocally making a distinction between these three terms (Brennen, Kreiss, 2014). Digitalization and digitization are often mixed terms, and the most vital point to remember is that digitalization cannot occur without digitization (see fig. 3). The main difference between digitization and digitalization is that digitization refers merely to the change of information format and provides the possibility to reduce the number of analogue operations (NextService, 2020). *Process Digitization* is a process of transformation to a digital format. The process is reproduced as it is today, and data is managed digitally (Robledo, 2017, para 3).

On the contrary, digitalization implies the transformation of processes and interactions. (NextService, 2020). Process Digitalization means that digital technologies are used to help to transform processes into more efficient and cost-effective. Therefore, "*digitalization allows the use of digital information to optimize business results and create new revenue, optimize costs, new customer experience... Offering so much value when applying digital technologies*" (Robledo, 2017, para 4). An example of digitization can be scanning a paper document into a PDF, transforming a paper form into a digital version, converting a VHS recording into a digital file etc. Examples of digitalization that denote a change of processes are following monitoring equipment with digital sensors instead of visual inspection, assembling products with a robot instead of by hand (NextService, 2020).



Figure 3: Digital transformation pyramid. (Collected from Arcweb.com)

Thus, such a difference between digitalizing and digitizing is both and valuable to discuss in this thesis. Organizations that grow and evolve with the development of new technologies should be robust to handle changes digitization or digitalization can bring. The next theoretical chapter addresses theories of organizational changes and explains challenges organizations can face with introducing digital solutions.

4.5 Organizational change

According to Jacobsen and Thorsvik (2020), there are two reasons organizations change: planned change and the need for organizational change. An increasing focus on digitalization in the maritime industry gives shipping companies a reason to change and improve their own organizations continuously. As a rule, planned change is related to strategical change, which means organizations adapt to surroundings changes. Examples of such changes in surroundings can be new information-, or communication technologies, technological change, or change in power relations that involves the approval of new regulations, standards, or laws.

Jacobsen and Thorsvik (2020) explain the differences between proactive and reactive changes, which are relevant in this context. Proactive changes are based on organizations' expectations, while reactive are formed as responses and reactions to already changing situations in the environment. In other words, organizations that change proactively take action before they are forced to change. On the other hand, reactive organizations change when the environment forces them to adapt to the situation (Jacobsen, Thorsvik, 2020).

Jacobsen and Thorsvik describe the importance of innovation and the development of new production technology that can give the possibility to streamline larger parts of the industry. Having a proactive mindset, with a focus on developing new products and services while improving existing processes, will be key factors for the industry in the future (Jacobsen, Thorsvik, 2020). An example of proactive change can be a shipping company that digitalizes checklists as a preventive measure to ensure safe operation, increase personnel's safety onboard, maintain equipment, and avoid environmental contamination. The management recognizes the need for improvements to comply with existing regulations and chooses to complete a proactive change.

Another example of reactive change can be when the shipping company have had several accidents caused by "human error" which results in big compensations required to be paid by the insurance company. In this case, the insurance company can potentially increase "Premium Payment" if the shipping company will take no measures. It means that the shipping company is forced to find a better solution to ensure safe operation on board.

According to Jacobsen and Thorsvik (2020), it turns out that change is usually met with resistance. Resistance to change is often intricately linked to emotions, yet researchers describe that resistance to change as a need to defend something well known and familiar. In general, the following reasons for resistance to change are defined by Jacobsen and Thorsvik:

- **Fear of the unknown.** For many groups and individuals, change links to uncertainty. *"The safest thing is to keep what you have, what is familiar; you never know what you will get. Uncertainty and dissatisfaction because of changes can easily lead to resistance to later change"* (Jacobsen, Thorsvik, 2020, p.379).
- **Fear to miss a position of power.** Resistance to change can appear as a position of power is altered. A change in process or organization can reduce the individual's access to the informational flow and thus can result in loss of decision-making power. In such a case, resistance to change appears naturally if an individual or group is afraid to miss power positions.
- **Loss of identity.** Over time individuals and groups built up a feeling of being valuable to the organization and identify themselves with their results and achievements in the company. A change in the organization can substantially impact an individual's job responsibilities, and therefore, an individual is afraid that his/her job can suddenly become meaningless. Such a change can make individuals feel as if they lost their own identity.
- **New knowledge and competence requirements.** Change in the organizational process can also lead to more specific competence individuals and groups. Such fear is as useful in the new circumstances-the more significant this specific competence, the more excellent the resistance to change.
- **Double work.** Organization change or change of process implies that for some period, work should be done twice. Such double work is a natural part of the transition phase. Thus, the change will require extra resources, and many will face resistance in terms of arguments about resource-intensive work.

Considering all the factors mentioned above, change of process can often be perceived as demanding. According to Jacobsen and Thorsvik (2020), it is essential to consider that resistance is not necessarily harmful but can benefit the company and employees. Simultaneously, resistance to change will provide indications on how strategies for change should be adapted and adjusted. Therefore, it may be wise to include employees in a change of processes to understand why and under which circumstances change is vital. The inclusion of employees in the change process can potentially reduce uncertainty and misunderstandings in the preliminary stages. Active participation of employees in change can help them develop positive relationships and build trust that facilitates the implementation stage.

4.6 Standardization and coordination

Last decades the development of modern technologies, digitalization, information-, and communication technologies (ICT) had increased their influence on organizations. Such development increased opportunities for better control, management, and coordination of work processes. Information systems have become more implicated in procedures, routines, and work descriptions, supplying a tool for work monitoring.

According to Jacobsen and Thorsvik (2020), modern technologies can improve coordination systems for administrative control and monitoring organizations' work processes. Organizations need access to information to make efficient decisions. Employees registering the result of their work in digital databases provide management with information that can be used to coordinate and control their work (Jacobsen and Thorsvik, 2020).

Iden, Bygstad, and Osmundsen (2019) have conducted a literature study of digitalization, which described how sociotechnical structures can indicate the interaction between social and technical tools. Researchers state that digitization is continuously changing the way you work, interact, communicate, analyze, conclude, and manage (Osmundsen, Iden, and Bygstad, 2019).

Recent studies present the information that the IoT can lead to better connectivity between the systems, making information readily available (Isakssona, Harjunkoski, and Sand, 2017). The IoT can facilitate and allow to collect and exchange of data on a more detailed level. As a result, such detailed information exchange will increase the importance of symbiosis between operational, management, and control functions, where control and all operational processes should *"co-exist in the same environment, supplementing each other"* (Isaksson, Harjunkoski, Sand, 2017, p. 68). On the contrary, Almklov and Antonsen defined digitalization as a *"critical catalyst for the increased ubiquity and increased level of detail of standardization"* (Almklov, Antonsen, 2019, p. 4). Authors mean that the digitalization of work control mechanisms can transfer some functions and decisions, making machine learning effective when human decision-making becomes reduced to a minimum. This may be challenging in terms of situational adaption to the environment as this is considered as key factor for operation completion. Likewise, digitalization and standardization of the work descriptions can reduce the leverage of situational adaption (Almklov, Antonsen, 2019).

To summarise, it can be said that checklists in maritime industry exist to ensure safe operation onboard vessels and make shipping companies compliant with the current regulations and requirements. In the modern society where digitalization is a not a brand-new word and it can be noticed an increased tendency to digitalise processes. Nonetheless misunderstanding in should definition of digitalizing and digitizing the processes exist. Additionally, introduction of digital process onboard can increase connectivity possibilities between shore organisation and vessels, but digital process can entail the reduced situational adaptability onboard. This theoretical framework would provide a basis for further discussion. Hereunder, the research methodology chapter will be presented.

5 Research Methodology

As mentioned before, this study's research topic is the use of onboard today, and the potential of the introduction of digital checklists. To satisfy the study's objectives and get a more in-depth understanding, a more holistic perspective on the topic, a so-called mixed research method was applied. The main aim of this chapter is to provide a justification over methodological choices underlying this bachelor thesis. The chapter will also present the trustworthy research methodology principles, such as the relevance of the study, reliability, validity, and ethical decisions of the chosen research method.

5.1 Research approach

The research process consisted of the following steps: definition of the research topic, the decision on categories to be analyzed, data collection, interpretation of the collected data, analysis of collected data, interpretations of the results, summarization, and conclusions.

Definition of the problem was the most time-consuming phase of the study as the previous experience from the summer project at DNV GL was both beneficial and challenging. As a part of the interdisciplinary team, we got inspired to study the topic of checklists more in detail, as we got more ideas about the study's future topic. On the other side, DNV GL's projects, related to digital checklists, confused us and resulted in the fact that we sometimes lost focus on the bachelor thesis's main research topic.

Practice around use of checklists, and potential of the introduction of digital checklists onboard vessels

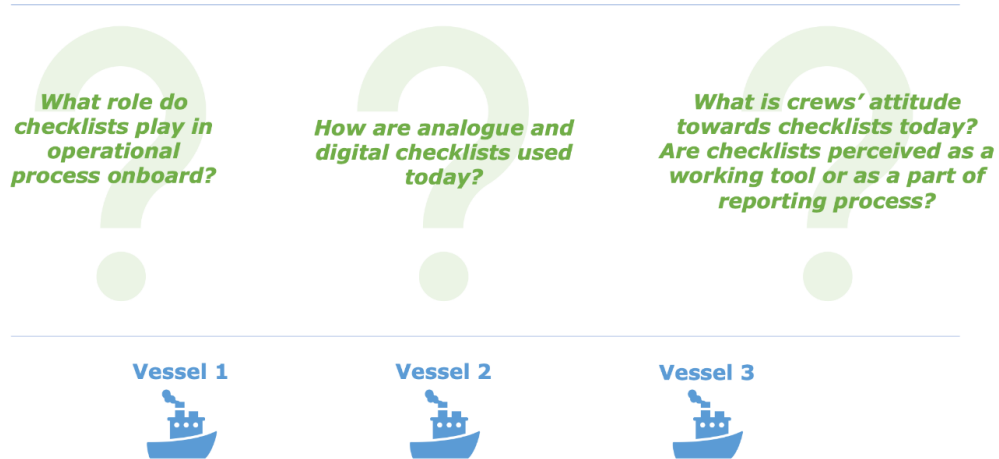


Figure 4: Overview of research questions.

Since this is an exploratory study, we decided to use both qualitative and quantitative research approaches. The triangulation method is described as two or more research methods used to illuminate a topic (Larsen, 2017). The empirical work was conducted onboard three vessels from various segments (see fig. 4).

The data was collected by interviewing crew onboard visited vessels and management representatives from shore organizations. In addition, one digital survey and 3 weeks with the observation of operational processes onboard were used as data collection methods. The participants were selected based on their knowledge, experience, and expertise concerning checklists' topic.

An important thing to mention is that the huge amount of collected data was structured based on the previously defined research question. During the analysis process, the goal was to increase readers' knowledge of the researched subject area (Tjora, 2018). The research questions defined the basic structure for the result and discussion chapters. This approach supplied the definition of valuable findings and supported data structuring in the result part of this study. Findings and learnings onboard visited vessels also contributed to the more profound understanding of checklists' role in the daily operational process onboard.

5.2 Data collection

To gather data about operational processes, interviews with crew members were conducted. Observations of the checklist usage as a part of the operational process were applied as well. Crew onboard the three different vessels were chosen as informants for this study. For our interviews we selected the key crew members onboard, since they are primary user of checklists onboard. For the digital survey, all crew members were selected as informants.

Data that is countable is called quantitative data, which means that it is possible to count different answers. This is often called hard-data (Larsen, 2017) and an example of this could be: How many sailors use checklists during everyday life? This data is countable, and it is possible to present the result with a number. In this thesis, we use digital survey as quantitative data collection method.

Qualitative data describes the informant's qualitative characteristics and is called soft data (Larsen, 2017). Usually, this data is collected through free text or quotation. Interviews and observation methods were used to collect this type of data. Data collected by these methods are defined as primary data, which means that the data was collected onboard, during our research process (Larsen (2017), Tjora (2018)). Compared with other data collection methods, the advantage of using observations is that we get direct access to the topic of research and a high possibility to register nonverbal behaviour (BRM, 2020). According to Robert Dingwall, observation is the best way to learn about the intersubjective construction of reality because observation forces to "listen to what the world tells us." Through observation, a researcher can study what people precisely do, not just what they say they do (interviews) (Tjora, 2018). This study observation method provided an opportunity to map the operational processes onboard and increase knowledge about the role of checklists in daily operations onboard several vessels. The mapping of the operational process was carried out with the focus on arrival and departure bridge procedures.

5.3 Interview process

This study aimed to evaluate the impact of digital checklists on the operational process onboard vessels. Hence five officers and six HSEQ managers were primarily chosen as interview objects. It should be noted that the interviewed officers' different backgrounds and experiences could have impacted the results of this study.

Two different guides for depth interviews were applied, one for crew onboard vessels and the other for management representatives. The interview guides were designed with open-ended questions, accompanying follow-up questions that allowed the informants to speak freely on the defined topics. Depth interviews onboard vessels were individual, conducted face to face, while the conversations with HSEQ managers were completed over Microsoft Teams (Larsen, 2017).

Interviews were recorded, and data were handled according to all ethical and General Data Protection Regulations (GDPR). All participants permitted to record their interviews, and recordings helped summarize the content of the interviews. Additionally, transcriptions provided the opportunity to support arguments in this study's analysis with direct quotes. After the data analysis process, interview objects were contacted again to ensure that the interpretations were formulated correctly. The authors approved each quote used in this study, and no changes or misinterpretations were made. Interview objects confirmed that the essence of their message during the interview and conclusions made afterward were understood accurately.

The interviews' primary purpose was to create a situation for a relatively free conversation about predefined topics. To make informants feel comfortable, talk openly and honestly about personal experiences, it was vitally important to create a good and safe interview situation (Tjora, 2018). As we were interviewing crew in their natural work environment, it made the interview situation casual. Prior to conduction of the interviews, time was spent on establishing a good relationship with informants during visits onboard. It resulted in much easier conversations, and we believed that interview objects dared to be as honest as possible. On the contrary, establishing a good relationship with the crew could result in a “subjective” attitude towards collected data and results

interpretation. Personal attachments to the interview objects could have increased the level of subjectivity and complicate the content of the analysis and result chapters.

<i>ORGANIZATION</i>	<i>"NAME"</i>	<i>INTERVIEW DATE</i>	<i>INTERVIEW LENGTH</i>	<i>INTERVIEW TYPE</i>
<i>SHIPPING COMPANY</i>	<i>Officer #1</i>	<i>Autumn 2020</i>	<i>1 hour 20 min</i>	<i>Individual interview</i>
<i>SHIPPING COMPANY</i>	<i>Officer #2</i>	<i>Autumn 2020</i>	<i>45 min</i>	<i>Individual interview</i>
<i>SHIPPING COMPANY</i>	<i>Officer #3</i>	<i>Autumn 2020</i>	<i>23 min</i>	<i>Individual interview</i>
<i>SHIPPING COMPANY</i>	<i>Officer #4</i>	<i>Autumn 2020</i>	<i>44 min</i>	<i>Individual interview</i>
<i>SHIPPING COMPANY</i>	<i>Officer #5</i>	<i>Autumn 2020</i>	<i>1 hour 14 min</i>	<i>Individual interview</i>
<i>SHIPPING COMPANY</i>	<i>HSEQ #1</i>	<i>Autumn 2020</i>	<i>1 hour 15 min</i>	<i>Teams call interview</i>
<i>SHIPPING COMPANY</i>	<i>HSEQ #2</i>	<i>Autumn 2020</i>	<i>1 hour</i>	<i>Teams call interview</i>
<i>SHIPPING COMPANY</i>	<i>HSEQ #3</i>	<i>Autumn 2020</i>	<i>48 min</i>	<i>Teams call interview</i>
<i>SHIPPING COMPANY</i>	<i>HSEQ #4</i>	<i>Autumn 2020</i>	<i>1 hour 28 min</i>	<i>Teams call interview</i>
<i>SHIPPING COMPANY</i>	<i>HSEQ #5</i>	<i>Autumn 2020</i>	<i>1 hour 40 min</i>	<i>Teams call interview</i>
<i>SHIPPING COMPANY</i>	<i>HSEQ #6</i>	<i>Autumn 2020</i>	<i>1 hour 52 min</i>	<i>Teams call interview</i>
TOTAL			<i>12 hours 35 min</i>	

Figure 5: Interviews with respective information.

The interview started with introduction questions about their career and current job responsibilities. Reflection questions constructed the core of the interviews. They aimed to push interview objects to reflect on the defined research topic. The questions could help interview objects to be as descriptive as possible and could help us to gather more reliable data. In an unfamiliar setting for the crew, we allowed them to use some time and think over before they answered (Tjora, 2018). In the end, we allowed informants to provide any other information they desired to add and their impressions of the interview. Afterward, we thanked respondents for their efforts and time used (Tjora, 2018).

5.4 Digital survey

To gather quantitative data for this bachelor thesis, a digital survey at Google Schemes was applied, mainly to get the crew's opinion on the topic of research. The anonymous digital survey was conducted onboard all three visited vessels. In total, 23 persons answered on the survey. As a data collection method, the survey can be defined as *"the collection of information from a sample of individuals through their responses to questions"* (Check and Schutt, 2012, p.160). To ensure anonymity a digital survey with a QR code was done. The digital platform would also help us collecting data more efficiently.

5.5 Validity and reliability

Terms validity and reliability refer to the trustworthiness and quality of the research study. Validity implies the research to be credible and trustworthy, e.g, to what degree one can have confidence in the study's findings. Reliability, or generalizability, implies that the study is consistent or dependable, e.g., if findings and learnings are consistent with the collected data (Jharkhand, 2014).

Validity indicates how, accurately a research method measures a phenomenon intended to measure (Larsen, 2017). In this study it was therefore essential to ask the informants about the current situation, and not draw any conclusions by talking to other people working ashore. If a study has high validity, it draws conclusions based on collected data (Larsen, 2017). To maintain validity in our thesis, we tried the conclusions were based on data collected. Validity indicates how accurately a research method measures the phenomenon that is intended to measure (Larsen, 2017). Therefore, it was essential to ask the informants about situations as is and not get affected by the conversations with representatives from shore organization. If a study has high validity, it draws conclusions based on data obtained (Larsen, 2017). To ensure better quality of the data and understand processes onboard vessels better, we participated in three voyages, each lasting one week. Moreover, in our case, we noticed that we were characterized by working in an innovation team, and sometimes we had to stop and ask ourselves, "on what ground do we have this conclusion". To maintain validity in our thesis, we had to keep reminding each other that conclusion should be based on the data collected.

To ensure reliability in qualitative research, the examination of trustworthiness is crucial. Reliability is an important focus when writing to ensure the credibility of the thesis. According to Larsen (2017), reliability is about both stability and equivalence. *Stability* in the sense that the survey design is stable and any changes that appear are due to development or changes in what we study (Larsen, 2017). *Equivalence* depends on whether the study is dependent on the people who complete the study or whether it will be possible to have the same data collections but completed by different people.

Regarding reliability in this study, we see that it is challenging to get honest and reliable answers from the crew, especially asking questions about their work assignments and routines. Several things could cause this, but trust and cultural differences are relevant in our case. We believe that establishing a good relationship with the informant was crucial to create a fair and open dialogue. We also believe that the fact that we have studied different vessels within different segments may strengthen and weaken the research's reliability. From one side, since we have been onboard one offshore vessel, we cannot generalize and apply results obtained to the entire offshore industry. In case, we had focused on one segment, for example, three supply vessels from the offshore segment, that would have strengthened the research's reliability.

5.6 Ethics

The ethical research issues will be addressed in the concluding part of the method chapter. The chapter's focus is the most crucial research ethics issues that deal with informed consent, confidentiality, and possible research consequences for individuals and groups (Busch, 2018).

First and foremost, we would like to point out that we worked on digitizing checklists at DNV GL for three months before we began our internship period. Three months is not long, but we still see that time has helped to influence how we think, and therefore an important point to include in this subchapter. According to Bush (2018), the student's relationship to organisation can affect the examined topic and the interpretation of the results.

When we started collecting data, we had already gained knowledge about how checklists work today, with insight into both the shore organisations and vessels. We thus believe that there is a probability that the methods for data collection may have been influenced and built on already existing information.

At the start of the project, both the students and the company's focus was that the thesis should be published, precisely because this is a topic that more people are interested in - but there is a lack of research. The project was therefore submitted to the Norwegian Center for Research Data (NSD), for approval. With publishing as a goal, the focus has always been on ensuring that the informants are not exposed. If the informant expressed opinions that referred to sensitive information, this has been treated with caution or removed at the respondent's request. Prior to the visit, the students and supervisor from DNV GL signed a confidentiality declaration to ensure that sensitive information that was possibly obtained should not be identified in connection with personnel or the shipping company itself. In order to strengthen the anonymity of the thesis, all the informants from the seaside were referred to as "officers" in the thesis, this in order to reduce the probability of recognizing the participants.

6 Analysis

6.1 Context of the study

To understand, explore, and compare the impact of analogue and digital checklists on the operational process onboard, we have chosen to examine three different shipping companies. Management gave us permission to go on board and sail with one of the company's vessels. This gave us the possibility to get an insight about the use of checklists in the daily context in which they are used. Hereunder in this chapter, each vessel case will be described in detail.

Number:	Segment/type:
Vessel 1, Case 1	<i>Offshore, supply</i>
Vessel 2, Case 2	<i>Container</i>
Vessel 3, Case 3	<i>General cargo</i>

Figure 6: Overview of the visited vessels.

Case 1

Vessel information:

The first case is a platform supply vessel operating in the North Sea. The vessel is approximately 98 meters long with accommodations for 14 people onboard. The vessel supplies different platforms with necessary equipment and operates with a route established beforehand every week.

Operations:

The vessel was on charter to Equinor, a Norwegian state-owned multinational energy company. The customer, Equinor, manages all the logistics and is financially responsible for the vessels fuel consumption. The shipping company makes sure that the vessel is prepared to execute necessary operations. Their operational processes consisted of loading, discharging, and delivering various types of cargo to different oil platforms and shore sides. Operations onboard are often affected by the heavy weather and waters in the North Sea, and thus vessel is technically equipped for such weather. Thorough consideration of weather conditions is a vital part of safe operational process. Crew has to consider daily whether meteorological conditions allow to continue operation or not.

During operations, the bridge was always staffed by 2 officers. That was sufficient to make sure that the workload is balanced. We noticed that operations were not affected by schedules or deadlines during our observations but rather done in a controlled manner.

Checklists:

UniSea checklists module is used today onboard the vessel, which means that checklists are available in a digital format on a tablet. The crew completed checklists simultaneously with the real operational process. In other words, before arriving at the port, they started the "Arrival Checklist" and completed it. Since there were 2 bridge officers on the bridge, one officer checked if arrival preparations were done according to the procedure/checklist and then completed the checklist. The other officer was in charge of navigation.

Case 2

Vessel information:

The second case is a container vessel built in the early 2000s. This vessel has a carrying capacity of approximately 700 TEU, is about 130 meters long with accommodations for 20 people on board, and is defined as a feeder vessel.

Operations:

The vessel operates on charter party contract with a logistic company and operates along the Norwegian coast all the way down to German ports. Their operations were affected by tight schedule and deadlines of containers delivery. The normal schedule included around 10-15 port calls during a week, sometimes with 2 port calls per day. Time, schedule, and efficient operations were always in the crew's focus. Moreover, time efficiency seemed to influence both operations and the crew's stress level. Crane operations and cargo handling were in focus and, as a rule, the reasons of delays. The crew was working as fast as possible to complete operations on time. In case of some delays, bridge officers immediately informed the agent and charter about the reason of delays. Crew was always striving for more time efficient ways to operate.

The bridge was staffed by 2 bridge officers during the daytime, while there was one bridge officer on watch at night. Captain was the only bridge officer onboard who had the Pilot Exemption Certificate, which means that the Captain was called up by to the bridge to sail in specified fairways or areas along Norwegian coastline and complete maneuvering at the port.

Checklists:

Checklists were laminated and readily available on the bridge. The crew did not have to complete checklists simultaneously with the actual operational process or sign them afterward. In other words, before arriving at the port, they had a laminated checklist "Arrival" available on the shelf. After the vessel was "All fast," the crew noted in the bridge logbook which type of checklist they had used during the operation.

Case 3

Vessel information:

The last case is a side door reefer vessel that can ship a wide range of various cargoes (Goodloading, 2020). It is about 80 meters long and has accommodation for 10 people. Minimization of time spent in port and optimal cargo space planning are key factors that help shipping companies and vessel owners get profit operating such type of vessel. If these elements are considered during operation, the vessel will have maximum earning capability (Macgregor, 2020).

Operations:

Their route goes from Denmark and along the Norwegian coast, all the way up to the north of Norway. They usually are seven people onboard- four people working on operations in the daytime and three during the night. All crew members are aware of vessel management's business side, and therefore, time efficiency was always in their focus. During the daytime, only one bridge officer was on the bridge, while at night or in bad weather, they were required to be at least two crew members.

Because of time pressure, all the crew members on watch worked during cargo operations, even the captain, 1st officer and chief engineer. Since they have a total capacity of 5500 m³ with frozen cargo and 730 m² general cargo on deck, there were many goods that needed to be loaded and unloaded; therefore, they needed all crew members on deck.

Checklists:

Today they use checklists inherited from a similar type of vessel, which is almost identically technically equipped. Checklists were printed out, laminated for further reuse, and available for the crew if they needed to refresh their knowledge. After operations, they noted the type of completed checklists in the bridge and engine logbooks.

7 Results

As mentioned earlier in the research methodology chapter, we have applied mixed methods of research to collect data such as observations, surveys, and in-depth interviews. Data collected with the help of the above-mentioned methods will be presented in the following chapter.

This chapter addresses the following research questions:

1. What role do checklists play in the operational process on board today?
2. How are analogue and digital checklists used today?
3. What is the crews' attitude towards checklists today? Are checklists perceived as a working tool or as a part of the reporting process?

Each quote corresponds to the informant number, mentioned in figure 5. The symbol (...) implies a pause an interview object is made to think over the question.

7.1 What role checklists play in the operational process onboard?

This research question addresses checklists' role in the operational process onboard and presents crew members and management representatives opinions from different shipping industry segments.

Management representatives and seamen express the general opinion that communication on board today is characterized by a lot of e-mail correspondence between shore organizations and crew on board. HSEQ manager states that e-mail is mostly used to request the necessary information.

"To reclaim the information from the vessel, we use a lot of email, so it is difficult to have control of things. You would not know if crew is using the latest version of a procedure or checklist." (HSEQ #5)

The informant explained that to comply with the ISM audit, the crew needs to use the latest version of the checklist. It means that, in case of revision of checklists, the crew needs to be updated about the changes made. Email usage can limit the control over the latest updates and result in the fact that the crew stays uninformed about changes and continues to use outdated versions of checklists.

Many of the management organization informants describe that the operational process onboard consists of many different parts. However, documentation of completed procedures, non-conformance reporting, and mail correspondence is an essential part of the daily operation.

"There are quite a few different parts of the operational operation. As HSEQ manager, I have a lot of reporting from the vessels that we, management, must follow up. There is a lot of documentation all the time." (HSEQ #3)

Most officers also state that administrative tasks are given lower priority in the offshore segment, while the operational process is always in focus. They pinpoint that administrative work is done either during the port stay or when the weather is good.

"It then depends on where you are going or what processes you are caring out. If the weather is good, as it is now, then I could have done some administrative work, or if we are on the base, I can have some time for paperwork. But the truth is that operational processes are in focus, which means I must do administrative tasks on my free time. Operational processes are always in focus. Unfortunately, administrative things are done either in the afternoon or at night." (Officer #2)

Another informant from the offshore segment highlights that bridge officers are obliged to follow extra rigid requirements from offshore companies. Informant explains that most offshore companies require shipping/management companies to comply with additional requirements. For example, Equinor requires supply vessels to follow, among other international regulations, Guidelines for Offshore Marine Operations (G-OMO) and Operation Manual for Offshore Service Vessels Norwegian Shelf (OOSFNS). This is directly linked to the operational process onboard vessels and means that seamen are obliged to follow requirements.

"We are two navigators on the bridge, so the bridge officer who is not in charge of navigation, is responsible for completing checklists. We have dozens of regulations and requirements we must follow, for ex. G-OMO and others." (Officer #2)

During the visit on board, one could observe that a vital part of the operational process was digital software usage, Equinor Vessel Log. Informants explained that it is used onboard vessels operating for Equinor in the offshore industry. This is a digital platform used for informational exchange between Equinor and supply vessels. Via this platform, vessels have access to future routes that have been planned and scheduled by the logistics department of Equinor. Moreover, operational processes onboard include "midnight report" in Equinor Vessel Log. The report consists of data points concerning both bridge and ME daily operations, e.g., LNG and fuel consumption or total sailing distance in the past 24 hours. These two examples show that offshore segment is affected by an extensive regulations and requirements from charters.

The offshore segment's officer says that their vessel is also obliged to follow additional requirements and regulations from charters, offshore, oil and gas companies.

"In addition to SOLAS and other regulations, charterers have their own requirements they want us to follow. They constantly come on board and check thorough vessels, even though everything has been approved by the class society they come and double-check or even triple check." (Officer #5)

It shows that the operational process onboard vessels in the offshore segment can be customized according to the regulations and requirements oil and gas companies set. In addition, both depth interviews and digital survey show that many different operational processes are linked to checklists and shipping companies' procedures.

"There are many complicated operations ongoing daily. You must complete checklist, Risk Assessment, Permit to Work. So, it is pretty comprehensive. Our vessels use mostly Dynamic Positioning, which means we have 10-15 different checklists for different types of operation." (Officer #2)

It shows that most operational processes performed onboard are directly linked to checklists. The general cargo segment officer expresses similar opinion that all processes related to navigation are linked to checklists. However, many informants express concern about the connection between operation and logical sequence of items in checklists. Management representant explains that checklists include many "irrelevant" items and indicates that it is challenging to create a useful checklist that reflects the operational process in the right way.

"The problem with the checklist is the definition of the most critical items. The most important here is to be able to divide the process into phases. Firstly, efficient work processes should be in place and only after critical points in the operational process must be defined." (HSEQ #6)

Another officer believes that the checklists are linked to the operational process and that a lot depends on the shipping company's effort in the revision of checklists. In the conversation, it has become known that prior to implementing digital checklists, the company has had a thorough review and revision of checklists, which apparently increased the quality of the checklists.

"Since we started using digital checklists last year, we had a good revision, especially of those related to DP and bunkering. The ones we had before were very generic, applicable for the whole fleet, and not applicable to this vessel. A captain revised. I was also involved in this process..." (Officer #3)

However, opinions are ambivalent regarding the topic if checklists reflect actual operational processes. The informant says that current checklists do not fully reflect the operational process on board today.

"They match with the operational process, yes, but the sequence is not correct. Some items are irrelevant, and checklists include so many things. The reason for that is that checklists are made ashore and that they apply to whole fleet of the shipping company." (Officer #4)

Officer affirms that e.g., arrival and departure operations are required to be recorded in Bridge Logbook. Some sections of checklists of arrival and departure should be checked and filled out before operations, while others should be completed in tandem with the operation.

Another example of how digital checklists can potentially affect operational processes is collected from a conversation between two officers on board. They describe how an operational process could be improved with the implementation of digital checklists.

“Informant 1: Every week before we start the bunkering procedure, we have to complete checklist X. According to our procedure, we are required to have one man at the bunkering station in case of fuel leakage.

Informant 2: But..... Normally there are not enough people on the watch to use for such task...

Informant 1: ...So, what do you normally do about it? Do you complete the checklists even though nobody is watching?

Informant 2: Yes.... This is a problem... Anyhow, I complete checklist X afterward of the operation, so if such an accident happens, my hands are clean.....

Informant 1: This is a huge problem with paper checklists today. Because all of the responsibilities are resting on my shoulders. But, if digital checklists were implemented onboard, that might have solved this problem... What if you had to complete checklist X, on a digital platform, and before you were allowed to start the bunkering procedure, you would have to get a confirmation from me first. So.... and in case of an accident, there would be no doubt on whom to blame.

Informant 2: Yes, that would have been really good!”

The informant talked about the captains’ responsibility onboard vessels today and how it always will be like that. He expressed how many crew members feel a lack of responsibility and engagement because they know that they will not be held responsible in any situation. Therefore, he believes that digital checklists could change this by increasing the crews’ responsibility towards operational processes according to procedures.

The quote can be interpreted as the officer states that digital checklists would possibly solve some organizational issues onboard; he describes how difficult completing of checklists simultaneously with the operational process would be.

“After sailing with us for one week, could you imagine us performing checklists like that? Like double-checking each other... I would have needed one more man at the bridge for doing checklists in parallel with the operational process.” (Officer #1)

Usually, the officer operates by himself and describes that checklists' performance would not have been impossible. Through observations, it was noticed that even if there were more than one person at the bridge during operations, they still perform checklists one by one. In other words, they do not communicate and double-check each other during checklists' operation and performance.

In sum, officers state that checklists do not fully reflect the operational process onboard due to different reasons. Moreover, the offshore segment officers mention that their operational process is affected by many industry regulations from clients before and additional requirements. Many of HSEQ and officers agree that operations today consist of documentation of completed checklists, procedures, non-conformance reporting, and mail correspondence. Officer also reflected on how digital checklists could ensure safer operations and reduce the chance of damaging the environment. Revisions improve checklists' quality, and they express the need for frequent updates to make sure that checklists always reflect the operational process. Operational processes onboard are described by navigations as paperwork and documentation. In the offshore segment, navigations and operations are always a priority, and administration tasks are often done during the officers' spare time.

7.2 How are analogue and digital checklists used today?

This research question addresses how analogue and digital checklists are used today onboard vessels. Digital survey and depth interviews were used to answer this question.

The digital survey results point out that most crew members onboard interviewed vessels still use the traditional pen and paper method to complete their work tasks. E-mail correspondence comes in second place.

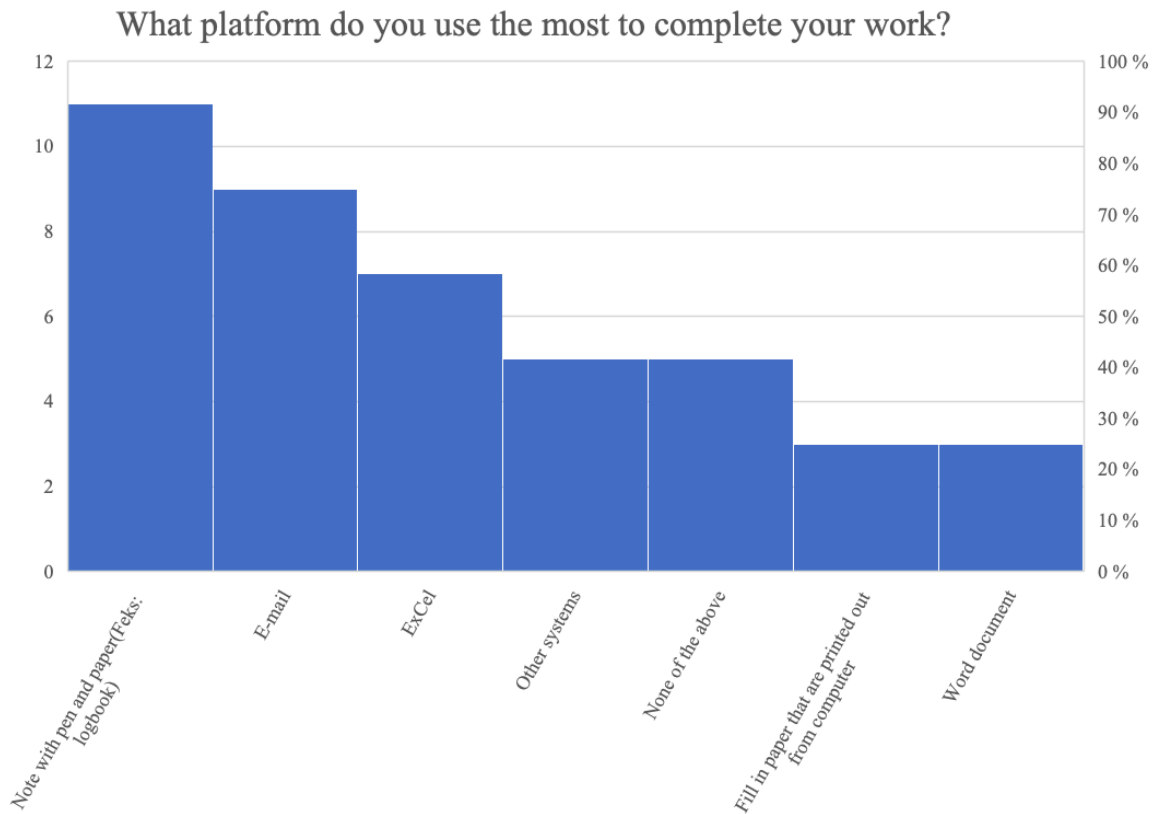


Figure 7: What platform do you spend most of your time on to complete your work assignments? N=23.

In an anonymous digital survey, 16% of respondents answer that the checklists are digital. The remaining percentage uses checklists in paper form, both laminated and printed out from a computer.

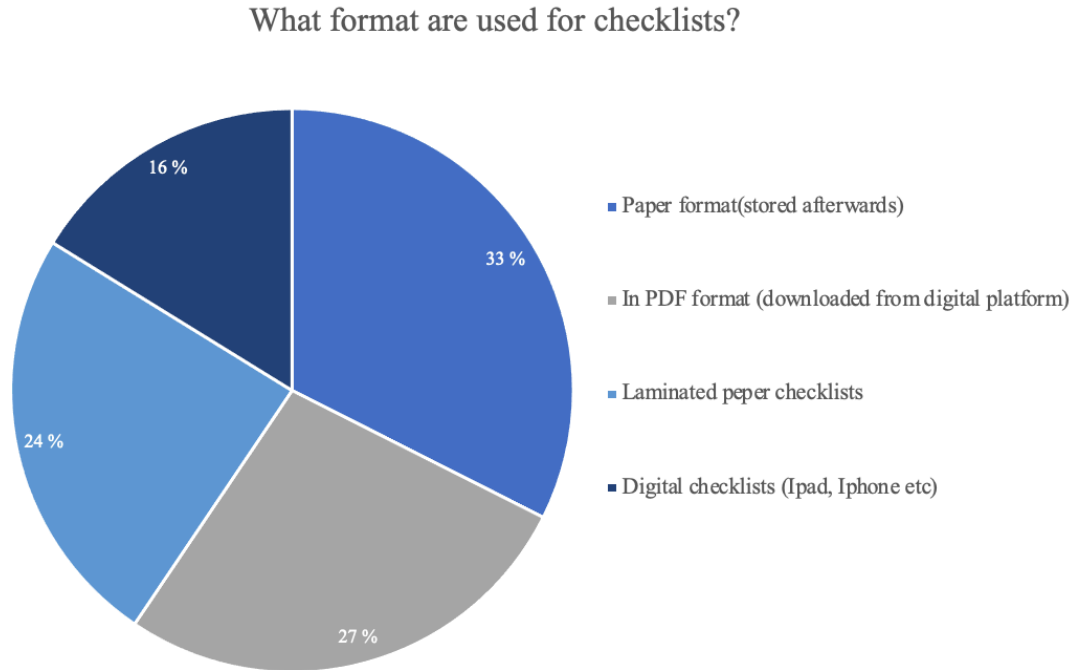


Figure 8: What format are checklists being used? N=23

Another essential point that supports digital survey data and arises during the depth interviews with the officers and HSEQ managers is their description of how checklists are used. To satisfy the study's objective and at the same time get a deeper understanding of how checklists are used today, the description of the process of use of checklists will be presented below.

In a depth interview with officer the same information arises that many checklists are in the paper format today. This means that the crew uses checklists in the following way:

1. Crew logs in to the PC on board;
2. Find checklists in a digital (PDF, Word) format in a shipping company's safety management system;
3. Print them out;
4. Fills in and signs completed checklists with a pen;
5. Stores checklists in ring binder on board.

HSEQ manager describes the abovementioned process in the following way:

“We have 150 checklists in total. There is not so many operations they can do without checklists. Checklists are on paper; they find checklists digitally on a PC, fill them out and store them in a binder. We use Ship Admin or Vessel Manager. When there is a change in the procedure, it can be easily downloaded and updated in the database and the crew can see changes on board immediately.” (HSEQ #2)

Another informant explains that they have digital SMS. It means that the crew has the opportunity to search checklists via the internal system and print them out. Further informant emphasizes that checklists are used in the following way:

1. Crew search checklist «template» in internal digital SMS
2. Print checklist out;
3. Fill in, and sign completed checklists with a pen;
4. Scan completed checklist and send it to the office.

HSEQ manager explains the process as follows:

“Crew can find checklist templates in a folder. It was printed and scanned. So, it will be a digital sheet one can say. There is a desire to get the checklists digitized, but it requires a lot of time and resources - and this in addition to everything else that happens.” (HSEQ #2)

Another informant from shore organization explains that some of the shipping company's vessels use digitized checklists, while others still have them in laminated form. As a rule, they are kept on a shelf on the bridge and are accessible for the crew anytime. The informant also says that the crew crosses off points in a laminated checklist and afterward verifies it in the bridge logbook.

“The intention with the laminated checklist is that they should be available. Crew only cross-check: yes, yes, yes... When items are crossed out, they stamp and verify it in the logbook in a following way: Completed checklist n.1, departure A.” (HSEQ #1)

However few HSEQ managers expressed their concern about the role of both digitized and digitalized checklists as a monitoring tool. Some of them mean that digital checklists' implementation can help increase the informational exchange between shore and vessel. However, HSEQ managers mean that digital checklists are not negative but can be used to monitor vessels' safe operation.

“With digital checklists, the crew may feel monitored by ashore and feel that they lose their freedom to do exactly what they want. But I do not look at it negatively, I think it is all about being professional.” (HSEQ #1)

When asked about the experience with digitized checklists, the HSEQ manager describes some positive points such as the reduced amount of paper, reduced costs for maintenance of printers, better environmental accounting, and less workload for the crew. The interview object also emphasizes that the introduction of digital solutions changed the crew's everyday work.

“Switching to digitization saves unnecessary annoyance by processing paper, filling it out, signing it, and putting it in a binder, irritation, time consumption, environment, you print maintenance and cartridges for printers... You can see that it is a completely new everyday life for the crew with digital solutions.” (HSEQ #2)

Furthermore, HSEQ states that an electronic reporting system can potentially make necessary information easily accessible for shore organizations.

“Such electronic system can definitely change my everyday life... you can find the information you are looking for much faster and easier.” (HSEQ #5)

To sum up, there are various formats of checklists. Some still use paper checklists, while others have them laminated. Informants point out that shipping and offshore companies want to replace traditional checklists with digitized. However, it is quite a substantial investment that not everyone is willing to take nowadays.

7.3 What is the attitude towards checklists today? Are they seen as a working tool or as a part of a reporting process?

Prior to the visits onboard, our impression was that there were mixed opinions about how checklists are used today and for whom they are made for. Management representatives, interviewed before voyages, mentioned that checklists are supposed to be a working tool for the crew onboard and exist for security measures. However, the crew expressed the opposite meaning that checklists' use is minimal, both before and during operations. Officers mean that use of checklists is beneficial for the shipping company and other stakeholders.

To answer this research question, we have done observations and monitored the crews' attitude towards checklists. At the same time, gather information from interviews and the digital survey was used. This research question focuses on whether the crew uses checklists for their own benefit or if it is something they feel obliged to do.

After multiple dialogs with crew onboard different vessels, we understood that the attitude towards checklists was mixed, but many had a common opinion that checklists are a part of the reporting process onboard. Therefore, the crew was asked the following question: Who do you think the checklists are made for?

“Informant: Do you want me to be completely honest?”

Interviewer: Yes, please.

*Informant: I feel that checklists are just thrown at us, just for the sake of pleasing the companies SMS system. I mean that if you have been through proper training, such thing as a checklist, should not be necessary. But when third parties like classification companies or other authorities comes onboard, I understand the need of documenting them. But do they know if we have done it or not? I am not so sure. Without this **documentation** we would not be ISM approved.” (Officer #1)*

An abovementioned quote can be interpreted as the officer refers to the checklist as a documentation tool necessary to comply with the ISM audit. Moreover, the informant describes that checklists are completed to make sure that the vessel follows established regulations. It can also be interpreted as the officer considers that checklists were created for safety measures, but, as time has passed, they have become more as a reporting platform.

In the digital survey, the crew onboard was asked to comment on the following statement: “I think that checklists are useful to document what I have done in connection with a work assignment”. The scale was from one to seven, 1= not agree and 7=totally agree. The diagram shows that the majority agrees that checklists can help to document completed assignments.

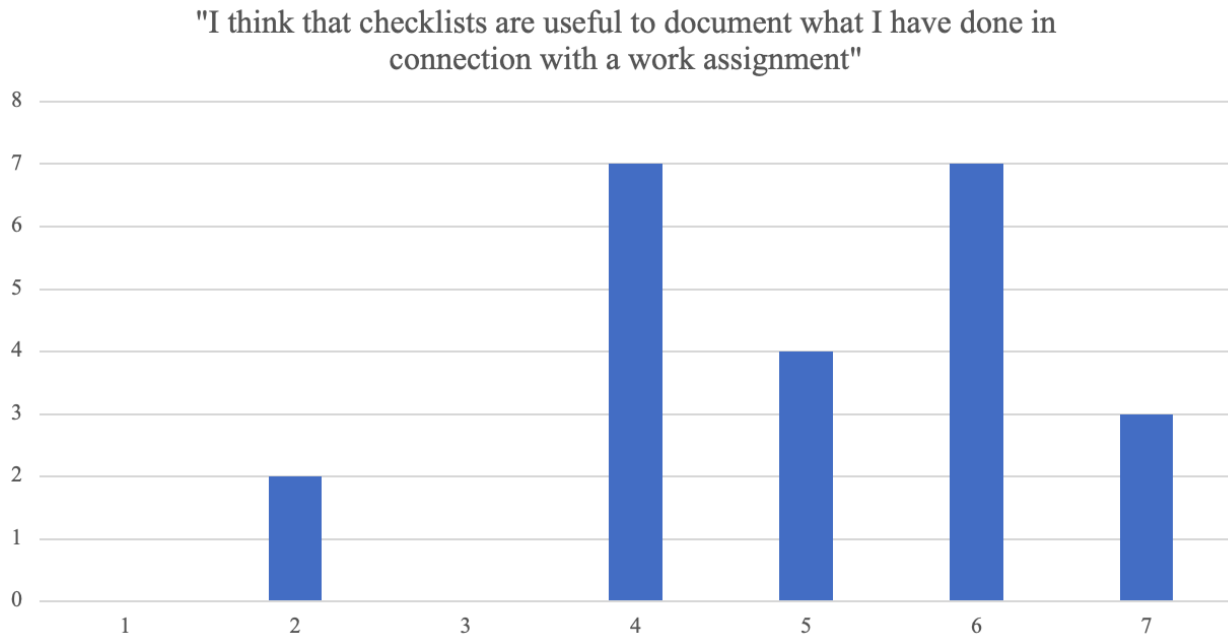


Figure 9: How checklists help in documenting for the completed work assignment, 1=not agree, 7= totally agree. N=23

The management representative is concerned of the fact that the crew is misunderstanding the purpose of checklists. They are trying to communicate why checklists are such an essential tool as a part of their daily routine.

“Checklists are not reporting, reporting is everything else. Checklist is for yourself, for double checking that you have done things right. We spend a lot of time getting the crew to understand that this is not for me (HSEQ), this is for them.” (HSEQ #6)

The same management representative informs that many maritime industries use checklists as “cover your actions”. He means that such attitude is completely wrong. According to his opinion there are two things are essential here: communication and a common understanding of what should be done. Informant also states that industry has not been tough enough to set rigid requirements around use of checklist.

“..the confirmation from the crew that they actually have done things right, should be received... not just that they write that something has been done.” (HSEQ #6)

Furthermore, the HSEQ manager explains that the crew has a lack of a positive attitude towards checklists, and the reason for that is the following:

“I think, crew has such a bad attitude towards checklists because: 1. They do not understand the usefulness of checklists 2. They do not have ownership to checklists, and we are not good enough at making good checklists.... of course, no one bothers to use a bad system. I think it lacks a fundamental understanding of the purpose of checklists, internally, in shipping companies.” (HSEQ #6)

Another HSEQ manager expresses similar concern about the motivation around the use of checklists. He says that their checklists are too long, and they contain much information that is not critical. Further, he points out that it can affect the crews' involvement level around the use of checklists.

“Checklists are too customer-driven. In shipping we see that checklists are more like procedures today, which means that it does not focus on critical elements that could affect the operation. They are too long, and not popular among the crew.” (HSEQ #2)

Furthermore, another officer believes that the motivation towards completing checklists would increase if they would have been shorter, more concise, and contained relevant information. Additionally, this officer believes that the crews' engagement will increase if checklists were available on a digital platform.

“It is frustrating that we have to complete checklists, were a lot of the items in the checklists are not applicable for us. I, therefore, believe that the motivation would increase after such revision. At the same time, I think that more people like to do checklists if they are digital, instead of completing them using pen and paper, and then do all the archiving later on”
(Officer #3)

Most of the crew that was spoken to was positive towards implementing digital checklists. But, one officer believed that such implementation depended on both age and engagement from key crew members onboard.

“Officer: But if we are going to digitize checklists onboard this vessel.... I think it will be implemented as new and young people start working here. But.. I can tell you that... you won't get the 60-year-old captain onboard X to start using digital checklists. Just forget it...But I think that if the information comes from me.. That we will start using digital checklists, to prove that we can do better....

Interviewer: So, you are saying that it would be difficult to implement digital checklists onboard vessels with elderly crew?

Officer: Yes, you can not teach your dad how to pee.

Interviewer: With other word, key crew members need to be engaged for such an implementation process?

Officer: Yes” (Officer #1)

Through this conversation, he explains how vitally important digital checklists' implementation would be, and that a basic digital knowledge would be valuable.

HSEQ #4 informs about how checklists are performed today and that all of them are completed before the operational process starts. He also describes checklists as a tool to ensure that procedures are being followed and used as a reminder during operations. Further, he describes how the crew are not allowed to start the procedure without a “permit to work”, and that all of the crew know what to do and uses checklists as an extra reminder.

Another HSEQ manager defines checklists onboard as a working tool and useful for documenting completed work;

“Checklists are there to document that they have done the work according to the procedure. Checklists are not useful for me as an HSEQ manager. It is mainly a working tool for the crew onboard. Of course, I would like to monitor that the processes are done correctly and receive feedback from the crew to make sure they are prepared for all operations.” (HSEQ #6)

The digital survey was used to get a better understanding of what the crew uses checklists for. The diagram below shows that 43% use checklists today to document what they have done, and 32% say that they do not use checklists at all. There is also 25% saying that they use checklists to check themselves of what they should do.

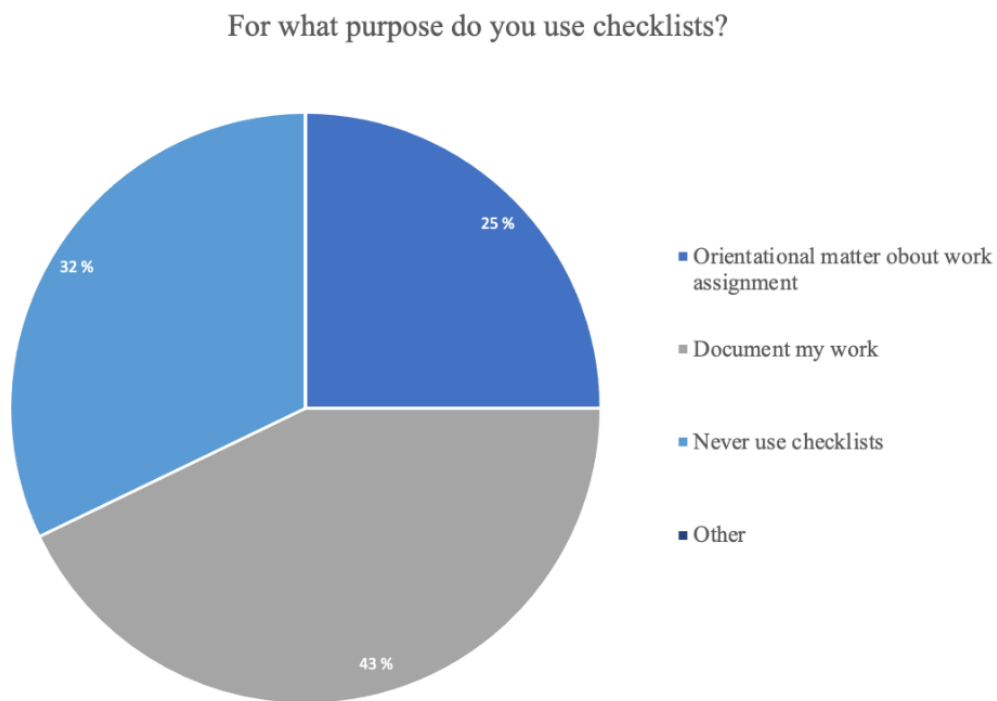


Figure 10: How respondents use checklists at work, N= 23.

Many officers think that checklists are good for reporting reasons, even though they understand the purpose of checklists' existence in the industry. They express concern about what would have happened if checklists were removed from vessels in the future. Their opinions are expressed below.

“If it would affect us? Not at all. Honestly, I don’t think we would have noticed anything. But in general... I think some needs checklists and procedures. Some needs to double check because the procedure does not feel like a routine for them. Or if there are a lot of things happening at ones, it is easier to follow a checklist. I have three bottoms to deal with, so compared with the guys working onboard an offshore vessel... I guess it like playing the organ in the church....” (Officer #2)

“Onboard this vessel it would not have affected us in any other way than that we would have done an even better job. Ha-Ha. But of course, checklists have come to stay, and I understand that. But if all of them have been deleted, I guess that there would have appeared some accidents. And when I look at the different humans working onboard vessels today.... I understand that anything can happen....” (Officer #1)

“I cannot say that my everyday life would have been better if we did not have checklists onboard. I understand the point of checklists... some are too long and some too short. We just have to accept that fact that checklists are there to ensure that our job are done with focus on safety.” (Officer #3)

“Informant: I think for sure that something bad might have happened. But I am quite sure that the consequence of doing something wrong is much bigger on the bridge.

Interviewer: What do you mean by that?

Informant: They have a bigger chance of doing serious error compared with us in the engine room. I mean mistakes like conjunction with navigations or other miscalculations. The risk is bigger, and I think it might have gone wrong without checklists. But on the other hand, accidents happen- using checklists or not. So, if there would have been any difference without them, I am not sure. But I think it is okay to have them onboard.” (Officer #3)

All these officers have one thing in common; they strongly believe that checklists exist, so that management representatives have documented evidence of the followed procedure. They understand the need and reason why checklists exist in the maritime industry, but none of them see the need to use checklists in daily operations. According to officers, the reason for that is that they are familiar with the procedure and have done it many times for many years.

To sum up, it can be stated that attitudes towards checklists from land and shore organizations differ to a certain extent. From the officers' perspective, today's checklists seem like a part of their reporting process and not like a working tool. The emphasis on checklists as a part of the reporting process can be argued by the informant's opinion and attitude towards checklists. HSEQ managers express frustration about crews' attitude towards checklists and state that checklists should be useful during operations. The majority of interview objects regarded the introduction of digital checklists as something positive. However, most of them meant "digitized," not "digitalized" checklists.

8 Discussion

The following chapter will present all three research questions and help answer the main research question (Busch, 2018): *Use of checklists, and potential of the introduction of digital checklists onboard vessels.*

8.1 What role do checklists play in the operational process onboard?

Many of the informants from three different sectors expressed opinions that daily operations onboard vessels should be done according to the procedures and checklists. Out of completed interviews, it can be noticed that some of the officers feel that current regulations and requirements have introduced only more paperwork into their daily operational process onboard, and such efforts to increase focus on safe operation onboard vessels are not welcome by seafarers. Theoretical background supports such an opinion. According to Knudsen (2019), several regulations and requirements that appeared in the shipping industry last decades have increased the checklist and procedures that seamen are obliged to follow in daily operations onboard.

Another critical point to be discussed is that most seafarers and management representatives explained that to comply with international regulations, the vessel must use the latest version of the checklist. It can be linked to the theoretical background around the ISM code, which presents the requirements shipping companies should comply with. ISM requires them to introduce SMS that demonstrates how a vessel meets obligations for safe operation. SMS, in turn, states that vessels must use the latest version of checklists. In this context, the latest version of the checklist is vital since vessels are obliged to maintain proper checklists for key shipboard operations concerning the ship's safety. Digitized checklists can have the potential to eliminate the challenges informants mention. As mentioned earlier in the theory chapter, such basis technology as connectivity, according to Andersen, Bjørnset, and Rogstad (2019) can lead to the increased possibility for shore organizations to “stay connected” with vessels via the internet. With the connection to internet, digitized checklists can be updated and synchronized anytime. Such solution can potentially help to solve the challenge with the latest version. In other words, it means

that digitized checklists can increase connectivity possibilities, can potentially reduce the challenged shore organization meet, and at the same time help seafarers stay updated on the latest changes of SMS, procedures, or checklists. Empirical data supports this opinion. We can see that 2 informants who have previously used digital checklists mentioned that connectivity and the digital solution is a very transparent tool about data sharing, which means that reports and updates made ashore are available onboard vessels immediately.

Furthermore, informants who have already started using digitized checklists pinpoint that digital checklists can help increase the quality of the checklists and, at the same time, make them more linked to the operational process onboard today. Degani and Wiener (1990) state that electronic checklists with a colourful display used in the aviation industry give pilots the possibility to better overview the completed operations.

Digitalization and digitization are essential to consider in this context because the influence of digitalized and digitized checklists on operational processes can be different. As described in the theory chapter, digitization and digitalization of the process are entirely different terms. In the empirical data, few informants mention that with checklists' digitalization, unnecessary paper consumption and irritation can be removed. In this case, informants relate to the transition from paper checklists into digital ones, which means *digitization* of the process. These two terms are entirely different, and it can be noticed that informants misunderstand them. The theoretical framework defines *digitization of process* as reproducing the process as it is (AS-IS), but in digital format. When companies reduce or eliminate paper use and start using digital storage of information. Such changes can be referred to as digitization. UniSea provider of digital forms and checklists, offers the same solution, a transformation and elimination of paper into digital storage.

8.2 How are analogue and digital checklists used today?

As mentioned before in the theoretical background, it is required by ISM code that SMS shall contain instructions and procedures to ensure safe operation. However, the ISM code itself does not say which format procedures, instructions, or checklists should have (ISM Code: Latest Updates, 2019). Informants from shore organizations tell that they use different formats of checklists and procedures. Some explain that they invested in digital SMS, but to reduce the cost, took the decision not to digitalize checklists, which means that checklists exist in PDF or Word format in digital SMS, and crew shall print them out before use. Other companies, such as offshore, have better liquidity and have implemented digital SMS and digital checklists onboard vessels. The abovementioned examples indicate deficiencies in a set of existing regulations.

The theoretical framework defines digitalization as a widely used term in the maritime industry today. The ships that become a source of real-time data collection can increase performance and operational planning and reduce the amount of workload. Such an introduction of new systems has increased the standardization of the work processes. Scientists Alkmlov and Antonsen (2019) imply that standardized paperwork description on paper can influence practice, while digital work procedures inscribed into the digital system can reduce leverage for situational adaption. Many of the officers expressed similar concern, answering questions about introducing digital checklists into their work life. Many of the officers believe that with the introduction of checklists, especially digital ones they will “forget to think themselves.”

Moreover, an interesting point to discuss in the ability to change. Seafarers seem to be positive to transform existing processes into digital ones, but are they motivated to change and make processes more efficient with the use of available digital solutions. According to Jacobsen and Thorsvik (2020), resistance to change can entail challenges organization should be prepared for. Seafarers stated that with the introduction of digitized checklists they forget to think themselves. The possible reason for this is fear of “loss of identity”, mentioned in theoretical chapter. In this context, seafarers build a feeling that they are valuable to the organization and identify themselves with the results of the company. Change of the process with the introduction of digital checklists can entail the change of responsibilities and make the job meaningless.

A tendency towards proceduralisation of the processes can be explained to coordinate operations in a more structured manner. According to scientists Kongsvik, Haavik, Bye, and Almklov (2019), demanding operations can be easier when operations are standardized. Many informants expressed their opinion on the dramatic transition from not having checklists to complete them digitally. They mean it is a negative development, mainly because checklists include too many items and are almost as comprehensive as procedures. This point can be confirmed in Almklov and Antonsen's article, where researchers describe that digital procedure can mostly have better performativity, which means that digital systems become an indivisible part of work execution. Through conversations with IT people and suppliers that there are three different formats of checklists. First, we have the traditional paper checklists that are either filled out or laminated and hung up. Then we have the electronic papers, i.e., electricity put on paper. Then the paper checklists are copied onto a digital platform. Finally, we have digitized checklists, which using sharing data points can make it possible for different systems to communicate together. For example, if the captain fills in the ETA in the checklist, this will automatically be generated for other systems that are interested in that information.

8.3 What is the attitude towards checklists today? Are they seen as a working tool or as a part of a reporting process?

Based on data collected, it shows that there is a mixed attitude towards checklists today. As shown through interviews, their attitude depends on whether they are working ashore or on board vessels. HSEQ managers believe in checklists as a working tool for officers, but officers do not feel the need to use checklists. The majority of the crew perceives checklists as a reporting platform that contains useful information for the management organization. HSEQ managers, on the contrary, express the opinion that checklists are not useful for them and shall be used as a tool for security measures. This part of the thesis will analyze the attitude toward both checklists as a working tool as well as a reporting platform. Findings from all data collecting methods shall be related to baseline theory in this thesis.

According to Jacobsen and Thorsvik (2020), the development of digital checklists increases opportunities for better control, management, and coordination of work processes. HSEQ manager confirms through an interview that he would like to monitor that processes are being done correctly onboard. And by usage of digital checklists, the management side could gain a better control and use such data for preventive measures. Officer #1 confirms this through his statement explaining how checklists are made for the sake of satisfying the SMS.

Such statements could be a resistance to change as a result of a feeling “lost identity”. Implementation of checklists, especially digital ones, could seem like a huge change in their work life. They are no longer able to do as they want to, without anyone noticing. This change could possibly feel like a loss of identity and create a distance between seafarers and ashore organization. The feeling of being undervalued, even underestimated by shore organization, could increase this distance (Knudsen, 2009).

There was brought up a concern about implementation of digitized checklists onboard vessels related to the age differences. Informants expressed their opinion on the fact that a lack of digital competence and resistance towards change. Can be related to the age. Since there will appear technological changes in maritime sector, seafarers shall be more prepared for such changes through their educational institution (Andersen, Bjørnset and Rogstad, 2019). This might indicate that introduction of digital (both digitized and digitalized) checklists onboard vessels in the maritime industry, might be a time-consuming process, due to the lacking digital competence among older generation.

Observations showed that there are different attitudes towards checklists in the offshore segment, compared with the others. Checklists were implemented many years ago in offshore segment, and therefore have become a part of their daily routine, and it does not seem like a burden for them. Officer #3 stated that his everyday life would be any better without checklists onboard.

According to Hales and Pronovost (2006), checklists are an important tool in error management, and a key instrument to reduce risk of costly mistakes. Based on information from officers, the reason why checklists today, do not seem like a useful working tool, is their lack of user-friendliness. Officers describes their checklists as long and outdated. During observations analogue checklists was not used because it was not seen as useful for them. Furthermore, officers using digital checklists, had troubles completing checklists because of its lack of touch functions. This indicates the need of developing checklists today, both digital and analogue ones.

Theory about organizational change, states that including crew in development of checklists could possibly increase their motivation. Checklists being revised by crew, and digital checklists made by people with operational experience, could ensure better quality. To increase the chance of crew showing resistance to change, proactive change is recommended. In this way organizational change, such as digitalization of checklists, could be properly planned.

Through this study, we figured out that the attitude towards checklists is different between the officers onboard and the ashore organization (HSEQ). Talking with both sides, their opinions are slightly different. Officers strongly believe that checklists exist for the matter of reporting to shore organization, but that they do not see the benefit of the usage of checklists themselves. These findings make us wonder whether officers think that management organization ashore shall trust their employees 100%.

Interviews with HSEQ was carried out in advance of sailing onboard, through observation we noticed that information from HSEQ did not fit with the reality onboard. The reason for this, is hard to define in this bachelor thesis, but could be a fact that shore organization should be aware of.

9 Conclusion

The present study aimed to analyze the role and use of checklists and explore the potential of digital checklists' onboard vessels within three various segments. The conclusion's background is depth interviews, a digital survey, and observations conducted during voyages onboard vessels from offshore, container, and general cargo segments. Depth interviews with the management representants from the shore organization are included in this study's empirical framework.

According to the theoretical framework, it can be concluded that checklists onboard visited supply vessels are “digitized”, which implies that the operational process around use and completion of checklists have not changed with the introduction of the digital checklists. Seamen onboard visited vessels seem to misunderstand the terms “digitization” and “digitalization” explicitly. Most of them believed that “digitized” checklists could be defined as “digitalized.” However, we can see that very few of them mentioned the digitalization of checklists to make the process more efficient. Most of them focused on reducing paper use and transforming paper checklists into digital versions. These findings can, to some extent, indicate that very few digital solutions existing on the market today provide the possibility of integration that can help reuse operational data gathered from ships.

Based on this study's findings, it can be summarized that crew onboard visited vessels is positive towards implementing digital checklists. Inconsistencies in attitudes between different sectors can be noticed. Within the offshore segments, increased regulations and requirements influenced the checklists' perception and crew attitude towards them. Crew onboard other vessels showed more resistance and less willingness to change. It might indicate that checklists have been used in the offshore segment longer, in comparison to other industries. Therefore, we can assume that the shipping industry, often describes as traditional and analog, requires time to become mature for such change.

On the one hand, digital checklists increase connectivity between shore organizations and vessels, which results in the increased level of coordination and informational exchange. On the other hand, digitalization can increase coordination and responsibility division onboard vessels.

Conducted interviews provide reflections on the potential of “digitalized” checklists. As current regulations do not set any requirements in terms of format of checklists, shipping companies can freely decide what format is the most suitable for their operational performance.

Thus, this bachelor thesis wants to underline the need to improve the maritime industry's checklists' quality, both analogue and digital ones. The general process of digitalizing the checklists is to make them digital and increase the possibility of reusing the data and creating the basis of standardized operational data from the vessels. This transformation is very ambiguous, and few of this research participants understand the value of the possibilities such digitalization can bring. Since international regulations and requirements do not require shipping companies to use the specific format of “digitized or “digitalized” checklists, shipping companies can decide freely either they will change proactive and implement digitalized checklists or they will be reactive and will introduce “digitized” checklists.

9.1 Suggestions for further research

This study focuses merely on crews' attitude towards checklists, the checklists' format today, the role of checklists in the operational process, and the potential of transforming analogue checklists into digital ones. Through this work, we have discovered suggestions of implications for future research.

Firstly, since our thesis is based on data collected from three different segments, it is therefore difficult to define a maritime pattern. Selecting one segment for a similar study could collect some exciting findings, focusing on culture and safety aspects. Secondly, we see problems connected to the implementation process in conjunction with digital checklists onboard vessels today. Developing a best practice based on how the implementation of a new system, such as digital checklists, should be done would be an interesting and useful study for the maritime industry.

Now, when operational data could be collected using a digital tool and sensors proved a data framework, the coupling between already available operational data onboard vessels with IoT data create more value for stakeholders in the maritime industry.

Since digitalized smart checklists that collect data from and data from other systems onboard, not yet been fully tested, it would be interesting to look at whether such checklists could affect the safety management onboard vessels. Would fewer accidents appear with such checklists implemented?

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Attachments

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Interview guide

Phase	Theme	Questions
Introduction questions	Experience	<ul style="list-style-type: none"> • How old are you? • What is your position onboard? • What are your main tasks? • Do you enjoy them? • How many years of experience do you have onboard vessels?
Reflective questions		<ul style="list-style-type: none"> • Coming onboard after some weak off, what is the first thing you do to orientate yourself? <p>-What kind of information do you see as valuable?</p> <p>-What platforms do you use to gain that information?</p> <p>-Have you ever experienced that you have not received enough information from someone working on the opposite shift? And what kind of information was that?</p> <ul style="list-style-type: none"> • Could you go through the different work processes that you do every day? <p>-What systems/programs do you need to complete such tasks?</p> <p>-What tasks are directly linked up with checklists today?</p> <p>-Do todays checklists correspond with the operational process?</p>
Reflective questions	Procedures/ operational processes	<ul style="list-style-type: none"> • What is your definition of a checklist? • What is your definition of a procedure? • How is the relation between checklists today and the actual process that you perform?
Reflective questions	Checklists	<ul style="list-style-type: none"> • How do you use checklists today?

		<p>-If you don't use them, can you explain why?</p> <p>- "People don't like using checklists today" do you think such statement is correct? Why?</p> <p>-At what point are checklists relevant?</p> <ul style="list-style-type: none"> • How does checklists effect your daily life? <p>-Why do you think there are checklists today? And for whom?</p> <ul style="list-style-type: none"> • How do you think that checklists should look like, to make sure they will be used? <p>-What kind of platform?</p> <p>-What does it take for checklists to be used?</p> <ul style="list-style-type: none"> • What role do you think that the shore organization shall have, in context with checklists and the performance of them? • What role do you think that the captain shall have in context with crew completing checklists?
Reflective questions	Digitalization	<ul style="list-style-type: none"> • What part of your work processes could change with digitalization? And why? • What is your opinion about implementing digital checklists onboard vessels today? • What does it take to digitize your checklists today? • How could digital checklists improve your workday? • Pros and cons about digital checklists?
Finishing off questions	Final questions	<ul style="list-style-type: none"> • What do you think would have happened if checklists were implemented in shipping? • Do you have anything to add regarding this topic?

Depth- interviews

Script:

We are two students from NTNU in Aalesund, that are currently studying Shipping Management. Right now, we are working on our bachelor thesis in cooperation with DNV GL, and we would like to look more into checklists onboard vessels today and possibilities for digital checklists. We are investigating ways of collecting operational data in a better way, and therefore we think it is interesting to talk to you as an HSEQ manager as a part of the shore organization.

Do you allow us to record this interview?

Introduction questions:

- Could you start with telling us a bit about the company you work in? And what type of vessels you are operating?
- What are the responsibilities of an HSEQ manager?
- What kind of challenges do you meet during you day at work? And how do you solve them?

Questions focused:

- Have some processes onboard been digitalized today? If yes, please explain?
- How do crew complete checklists today? And for whom are checklists made for?
- What is expected of you as an HSEQ manager?
- What kind of data are available for you (from the vessel) today?
- How do you use such data?
- If some data are missing/not available, what do you do? (phone call, e-mail etc.)
- What data/information are important for you?
- Are there any strategies according to HSEQ work?

Thank you so much for your time, this was very valuable for us. Any sensitive information will be handled gently, and the interview will be anonymized.

Digital survey

Total time spent reading: 10 min

This is an ANONYMOUS digital survey made by two students studying Shipping management at NTNU in Aalesund. We would do this survey onboard three different vessels in the maritime industry. Therefore, we want to emphasize that it is not possible for the reader to identify either which shipping company or vessel we have used in this bachelor thesis. We have signed a confidentiality agreement with the shipping companies we work with, because we think it is incredibly important that you trust us and that you feel that you can bring honest feedback towards us.

This study will be a part of our last big assignment at our bachelor's degree "Shipping management", and we wish to write a good thesis that reflects the real opinion about checklists from people working onboard different vessels today. Digitalization is a big part of the industry today, and a lot of changes will come. Today people are working with digital solutions with the aim to ensure safe operations at sea, therefore we think it is important to listen to the "real users" opinion. How does the process regarding checklists work today, and if it is not working, why so?

Thank you so much for using 10 minutes of your spare time to help us with this study, so we can earn more knowledge and do changes in the future to make the "tomorrow" even better!

Best regards Yuliia Demshevska and Elisabeth Hammerø

How old are you?

- 18-25
- 26-35
- 36-45
- 46-60
- 61-70

How many years have you worked at sea?

- Mindre enn 5 år
- Mer enn 5 år
- Mer enn 10 år
- Mer enn 20 år
- More then 30 years

Do you enjoy your job?

- Yes
- No
- Sometimes yes, sometimes no
- No comment

What digital tools/platforms do you use as a part of your workday?

- Computer
- Smart phone (Iphone, Samsung, Huawei etc)
- Smart watch
- None of the above options

For what reason do you use checklists today?

- To get orientated about my work assignment
- Document my work assignment
- Do not use checklists
- Other

If your answer was “other”, could you explain?

On what format are checklists today?

- Paper checklists, signed and stored
- Laminated paper checklists
- In PDF format, stored in a digital system and printed out afterwards
- Digital checklists performed on either iPad, smartphone or computer

If checklists were digital, how would you prefer them?

- Smart phone
- iPad
- Computer
- Smart watch

Have you ever experienced that you were missing information to complete a task? When did this happen?

- Today
- This week
- This month
- This year
- Never happened

If yes, how often do you experience this?

- Daily
- Weekly
- Monthly
- Rarer

What kind of information were missing? Please explain

What platform is most time consuming, to complete your work tasks?

Notes with pen and paper (Such as logbook, checklists and other documents)

- ExCel
- Word document
- E-mail
- Other systems
- No not spend any time on above systems/platforms

When was the last time you were frustrated at work?

- Today
- Yesterday
- Last week
- Last month/year
- Never been frustrated

If yes, could you please explain the reason why?

On a scale from 1 (totally disagree) to 7 (totally agree), how much do you agree on the following statements?

I feel that I have good access to the information I need to carry out my work

1 2 3 4 5 6 7

Today's reporting process allow me to document my work in an appropriate way

1 2 3 4 5 6 7

I think checklists are useful for documenting what I have done in connection with a task

1 2 3 4 5 6 7

Today's arrangements for documentation / reporting are effective

1 2 3 4 5 6 7

The use of checklists is mainly useful for ashore organization

1 2 3 4 5 6 7

Digital checklists will be challenging due to internet access

1 2 3 4 5 6 7

Digital checklists will make my workday easier

1 2 3 4 5 6 7

Digital checklists will make it possible to reduce reporting

1 2 3 4 5 6 7

Digital checklists will to a greater extent force me to do my work tasks according the procedure.

1 2 3 4 5 6 7

Do you think that digitization on board will make your everyday work easier? If "yes" or "no" feel free to explain!

What would make your everyday at work easier?

Do you have anything to add regarding this topic?