Technical support at sea

Quantifying its problems and examining possible solutions

Bachelor thesis for the International Logistics Program

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Gothenburg, Sweden, 2024

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A case study on reducing the need for technical assistance and enhancing the support function.

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Cover:
A sunken ship amidst the sea, with a sailor on the dock holding a telephone calling for technical support. Painted by Samuel Svedlund.

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PREFACE

Over the past three years, we have been studying International Logistics at Chalmers University of Technology in Gothenburg. This bachelor thesis marks the end of this period.

Focused on technical support onboard ships, the report handles an interesting (and important) topic, one that our mentor Monica Lundh guided us towards. Her support during the work on this thesis has been amazing, providing us with both ideas and encouragement. A big thank you Monica.

We also extend our thanks to all the shipping companies that assisted us in contacting onboard personnel for our survey, and the people who responded. We hope that you can benefit from our report when shaping the support systems for the future.

Arvid and Samuel

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SAMMANDRAG

Digitaliseringen har blivit alltmer närvarande i sjömäns arbete vilket lett till avgörande framsteg för industrin. Ny forskning indikerar dock att den nya digitala miljön medför vissa utmaningar, varav en är teknisk support. Den här rapporten syftar till att undersöka utmaningarna och möjliga förbättringar inom teknisk support ombord på fartyg i och med den maritima industrins ökande digitalisering. Forskningen fokuserar på två huvudfrågor. För det första, vilken omfattning har de identifierade problemen i teknisk support ombord på fartyg? För det andra, vilka åtgärder för att förbättra supportfunktionen föredras av sjömän? Resultaten är främst baserade på data insamlad i en enkätundersökning, som ger en bild av den nuvarande situationen kring teknisk support till sjöss.

Resultaten pekar på att teknisk support som helhet inte anses vara ett avgörande problem, men att det ändå finns rum för förbättring inom vissa områden. Flera olika problem förekommer, som exempelvis otillgänglig support, språkbarriärer och fördröjningar i svarstider. Sjömän föredrar traditionella kommunikationsmetoder, såsom telefon och e-post, framför moderna alternativ som exempelvis chattbotar och videosamtal. Dessutom betonas vikten av att ha en dedikerad kontaktperson med kunskap och kompetens på supportföretaget som en viktig faktor för att förbättra supportkvaliteten. Det är viktigt att förbättra befintliga supportfunktioner genom en ökad kompetens och tillgänglighet. Istället för att förlita sig på nya tekniska lösningar är det avgörande att utveckla de redan befintliga traditionella alternativen för att förbättra supportfunktionen inom den maritima industrin.

I rapporten undersöks IT support för administrativa och operativa tekniska system ombord på fartyg ur användarnas perspektiv, det vill säga besättningens. Rapporten är begränsad till support på fartyg hos redare som är verksamma i Skandinavien.

Nyckelord: teknisk support, sjöfart, digitalisering, användarcentrerad design

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ABSTRACT

Digitalization has become increasingly prevalent in the work of seafarers, leading to major benefits. However, recent research indicates that the new digital environment brings its challenges, one being technical support. The aim of the report is to investigate the challenges and potential improvements in technical support onboard vessels within the context of the maritime industry's increasing digitalization. The research focuses on two main questions. Firstly, what is the magnitude of the identified problems in technical support onboard vessels? Secondly, which measures to improve the support function are preferred by seafarers? The results are primarily based on data collected in a survey, revealing insights into the current state of technical support at sea.

Findings indicate that while technical support is not seen as a major problem, there are several areas of improvement. Issues such as inaccessible support, language barriers, and delays in response times exist. Seafarers express a preference for traditional communication methods, such as telephone and email, over modern alternatives such as chatbots and video calls. Additionally, having a dedicated contact person with knowledge and competence at the support company is emphasized as an important factor for improving support quality. It is suggested that improving existing support functions through increased competence and availability is important. Rather than relying solely on new technical solutions, enhancing the already existing traditional ones is essential for improving the support function in the maritime industry.

In the report, IT support for administrative and operative technological systems on vessels is investigated from the perspective of the users, i.e., the crew. The scope is limited to support on vessels of shipping lines operating in Scandinavia.

Keywords: technical support, shipping, digitalization, user centered design

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ACRONYMS AND TERMINOLOGY

AIM	Advanced Intelligent Maneuvering
ARPA	Automatic Radar Plotting Aid
BIMCO	Baltic and International Maritime Council
COLREG	International Regulations for Preventing Collisions at Sea
EfficienSea	Efficient, Safe and Sustainable Traffic at Sea
HCD	Human Centered Design
IMO	International Maritime Organization
ISO	International Organization for Standardization
MASS	Marine Automated Surface Ships
MONALISA	Motorways & Electronic Navigation by Intelligence at Sea
STM	Sea Traffic Management
UCD	User Centered Design
WAD	Work as done
WAI	Work as imagined

1. INTRODUCTION

Throughout history, the maritime industry has changed several times through various technological revolutions. The digitization that is taking place now can be seen as part of the Fourth Industrial Revolution, or Industry 4.0 (Schwab, 2017). The new vessels in the Shipping 4.0 era use, for example, extended computerized systems and autoystems, and are called SmartShips (Ichimura et al., 2022). This development has resulted in multiple benefits for seafarers, including reduced administrative work, reduced errors, improved safety, and timesaving (Schubert et al., 2022). Technology does, however, have its drawbacks and has occasionally proved to be counterproductive (Lützhöft, 2004). In a study led by Swedish Shipowners´Association and Chalmers University of Technology, several issues in connection to digitalization onboard were identified (Lundh et al., 2023). One was that the technical systems are too complex, leading to misinterpretations and information overload. Another was that small technical issues can lead to big consequences.

The most common problem, however, according to the study, was the inconsistency of the support function for the digital services and devices. Being operational more or less 24/7, getting support in time is not a guarantee. Time differences considering the global scope of the business does not make the situation easier. The consequences of malfunctioning technology on a vessel can also be extensive, impacting seaworthiness (Lundh et al., 2023).

1.1 Background

This study serves as a continuation of the report: "*The impact of digitalization on maritime safety and the work environment of the crew* "(2023). Trafikverkets case number: TRV 2021/100835.

Findings of that report, regarding the impact of digitalization on the work of seafarers, are expanded upon, with a particular focus on technical support. By exploring the support function in greater detail, the objective is to gain a deeper understanding of the issues that exist today, and to gain insights into how the support function can be changed and made more user friendly. In the report by Lundh et al (2023), it is discussed how increased digitalization onboard vessels as a part of the 4th industrial revolution affects the work for seafarers. Stakeholders in the industry were interviewed, and several issues related to increased digitization were identified. These include the design and user friendliness of the digital systems, and that a high degree of complexity harms interoperability between different systems as well as making them hard to use. The biggest problem highlighted in the report, however, is the lack of technical support and its shortcomings (Lundh et al., 2023).

One shortcoming that was brought up during the discussion with focus groups and interviews that were a part of the study, was the vast consequences resulting from not having support available when needed (Lundh et al., 2023). Another is long waiting times for answers from the technical support, and a third is that unstable internet connection (which can be a problem at sea) prevents online support. Sometimes, the systems must be restarted or have their software updated during the support process, which could also be time-consuming and result in delays. Despite some support-requiring problems being comparatively minor, they could result in the ship not being seaworthy and thus prevented from leaving the port (Lundh et al., 2023).

1.2 Aim of the study

The aim of this study is to investigate the extent of previously identified problems with technical support for equipment and systems onboard vessels. The study also aims to examine possible improvements to the way technical support is carried out today.

1.3 Research questions

1. What is the magnitude of the identified problems of technical support on vessels?
2. Which measures to improve the support function are preferred by seafarers?

1.4 Delimitations

In the report, the focus is on investigating IT support for administrational and operative technological systems on vessels from the perspective of the users, the crew. The scope is limited to support on vessels of shipping lines operative in Scandinavia.

2. THEORY

The theory chapter presents a historical scope of the digital transformation of shipping, which forces that are drivers of the development, and to some extent how new technology is impacting its users. This chapter also looks at the relation between technical support and the user, as well as alternative ways to implement or partly replace the support function.

2.1 Digitalization on vessels

The digital transformation of shipping brings the potential of improvements in multiple areas, including reduced environmental impact, more efficiency and improved safety (Babica et al., 2020). Due to the global scope of the shipping industry, however, digitalization and standardization is slower compared to other industries. There have been initiatives from regulators to utilize the technological development for benefits in shipping. E-navigation was introduced by IMO, International Maritime Organization, in 2006 and consists of continuously developing standards for improving safety, security, and environmental protection for shipping, utilizing technology (IMO, n.d.-b). The standards, that concern the navigation of the vessel, include suggestions of how digital equipment should be used, how data should be presented and how the data is transferred. The focus is not so much on development of new technology, but rather how the integration of existing digital tools for navigation assistance can be enhanced (Zhang et al., 2021).

Another initiative by IMO is the regulation of MASS, Marine Automated Surface Ships (IMO, n.d.-a). IMO is working by addressing the opportunities and challenges of autonomous shipping that comes with the increased digitalization and technological advancement in the maritime industry. By regulating these new vessels, IMO aims to ensure that safety standards remain high. There are four different levels within MASS, which all require different regulations. The first level is a vessel equipped with some form of automated processes, where personnel are still on board to control and operate the ship's systems and functions. Personnel in this level should be ready to take control of an automated system directly. In level four, the highest level, the vessel is instead fully automated. Here, there is no personnel available on board. The vessel then navigates itself, and the systems autonomously make all decisions (IMO, n.d.-a). MASS is a clear example of the increased digitalization on vessels in the maritime industry, where the importance of a stable and well-working technical support is evident to ensure safe operations.

2.1.1 Benefits and Challenges of Technological Integration

An organization that invests in IT has proven to bring benefits to the owners, in form of better results and higher value of the company (Engelen et al., 2022). The owners also see benefits with digitalization in terms of increased safety for onboard employees and better optimization due to reduced administrative work (Schubert et al., 2022). There are however benefits for the employees as well. For example, by automating repetitive tasks, time is given for the employee to perform more interesting tasks, which increases job satisfaction (Engelen et al., 2022). Both the employees onboard and the owners believe that the increased technical use of digital tools is mainly positive (Schubert et al., 2022).

When it comes to challenges, digital systems have disadvantages when the end user of the system cannot use them as they normally do. In these cases, it is necessary for the seller of the system to provide some form of technical support (Allen et al., 2013).

2.1.2 History of digitalization

The world has undergone several industrial stages over the past decades, resulting in major technological changes of the shipping industry (Ichimura et al., 2022). The first stage, during the 18th and 19th century, steam power was introduced. The steam engine enabled a large increase in shipping capacity and much shorter transit times, compared to wind power. The second stage, between the 19th and mid 20th century, brought mass production, powered by electricity. Finally, the third stage, that started in the mid 20th century, introduced electronic information technology to make manufacturing even more efficient (Ichimura et al., 2022). With this third stage, the introduction of new technologic equipment in shipping has escalated drastically, particularly when it comes to navigation (Conceição et al., 2018). This has shifted the tasks of navigators from more revolved around execution and surveillance, to planning and monitoring through the adaption of onboard sensors, shore based maritime services, databases, and ARPA (Automatic Radar Plotting Aid). Eventually, an increasingly larger portion of the work performed aboard will rely on digitization and technical systems. Younger employees onboard the vessels are generally more positive to using digital tools compared to their older colleagues (Schubert et al., 2022).

2.1.3 Research initiatives within digitalization in the shipping domain

Over the years there has been several research projects that has developed digitalized navigation aids and decision support systems. All of them aiming at increasing the safety of navigation. Among those, MONALISA, Motorways & Electronic Navigation by Intelligence at Sea, was among the first. It was an EU project that took place between 2010 and 2013 (Porathe et al., 2014) and its purpose was to improve safety, efficiency and reduce environmental impact (STM, n.d.). MONALISA 2.0 (2013 – 2015) built on the previous project and resulted in a standardized route exchange format and improvement in the interoperability between ship equipment from different manufacturers (Aylward, et al., 2020b).

STM, Sea Traffic Management, was then developed within MONALISA 2.0 and revolves around information sharing (Aylward, et al., 2020b). The project resulted in the development of decision support functions that can optimize voyage plans through the integration of real-time data, including information from meteorologists, ports, particularly sensitive sea areas and maritime safety information. Thus, more informed decisions could be made and efficiency, safety and environmental performance at sea improved (Aylward, et al., 2020b). Despite leading to less miscommunications, the changes in workload and communication patterns resulting of the implementation of STM have shown to cause information overloads for vessel traffic service operators (Aylward, et al., 2020a).

Later on, AIM, Advanced Intelligent Maneuvering, a navigation decision support system was developed by Wärtsilä (Aylward et al., 2022). It can use data from surrounding traffic to suggest alterations of speed and course, in order to avoid collisions and is continuously updated depending on the traffic situation. Navigators on ships need to follow COLREG, the International Regulations for Preventing Collisions at Sea, and AIM can be important in assisting the navigators to comply with these regulations in cooperation with other systems such as ARPA (Automatic Radar Plotting Aid) and AIS (Automatic Identification System) (Aylward et al., 2022).

EfficenSea (Efficient, Safe and Sustainable Traffic at Sea) was an EU e-navigation project divided into two phases (Du et al., 2016). EfficenSea (2009 – 2012) was a project in the Baltic region, aiming for efficient, secure, and sustainable transport in the area. AIS, VTS, NAVTEX and radar were utilized to enable an information exchange service between vessels, real-time sharing of hydro metrological information, a route information exchange service maritime, a safety information services and a search and rescue service. EfficenSea2 (2015 – 2018) attempted to achieve the same goals as EfficenSea by implementing new smart digital solutions. These include cloud services for information exchange between maritime sectors (Du et al., 2016).

2.1.4 Future of Digitalization - Industry 4.0 and Shipping 4.0

The concept of a fourth industrial stage, the industry 4.0, and the idea of constantly present computer technology was introduced in 2011 during the Hannover Fair and later implemented in a strategic plan for the manufacturing industry by the German government (Ichimura et al., 2022). However, the concept can be traced all the way back to 1991 when it was mentioned by Mark Weiser (Stanić et al., 2018). The main ideas of the Industry 4.0 include interaction between reality and the virtual world, Big Data, Internet of Things, Internet of Services, and the Cyber-Physical Production System. According to Ichimura et al. (2022), there are predictions of two different ship types emerging as a result of the digitalization and Industry 4.0, smart ships and autonomous ships. Smart ships utilize modern technology to improve traditional vessels, including computerized systems, automation of tasks onboard and increased monitoring of navigational systems. Autonomized ships on the other hand have systems to navigate and make decisions without human interaction and are not necessarily manned (Ichimura et al., 2022).

2.2 System design - WAD / WAI

To be able to successfully design technology, it is essential to understand how work is performed from the operators' perspective. This can be described as WAI (work as imagined), which refers to how work is being thought of and described while WAD (work as done) refers to how work is carried out in practice and thought of while doing so (Wears & Hollnagel, 2017). These different perspectives generally do not align, since describing a work situation precisely without any source of variability or uncertainty is impossible in most environments. When attempting to describe the work that is carried out, some information is usually excluded since certain skills and competences are taken for granted. This is necessary since it would be impossible to consider and describe all situations that can occur in a work situation. However, it means that in some cases when working conditions are not specified, the worker needs to interpret what he / she is expected to. WAD represents practice and WAI the ideas about practice. While the ideas tend to be more immutable, the practice alters continuously and adopts as the working environment changes. Furthermore, WAD and WAI often start to differ more and more as the information is moving further away from where the work is carried out. This can get particularly problematic in large organizations and hierarchies (Wears & Hollnagel, 2017).

When WAD and WAI are misaligned, the best solution is usually to adjust both simultaneously (Wears & Hollnagel, 2017). WAI can be changed to better represent WAD by reducing the delay in which the information of actual work practices is shared, as well as to make that information more precise and detailed. WAD on the other hand can be changed if those who carry out the work are more aware of the context and purpose of what they are doing. Furthermore, the gap could be reduced by removing communication barriers resulting of, among others, tradition, hierarchical structure, and roles (Wears & Hollnagel, 2017).

2.2.1 Human- and user-centered design

Once it is understood how work is done, a good design requires an iterative process where the end-users are involved from the beginning. Human-centered design, HCD, is when the design process of an interactive system has the human in focus. The design of systems must focus on how it is used in practice by humans, and on what is known that humans prefer and need. (Giacomin, 2014). There is an ISO standardization for human centered design, ISO 9241-210. This standard sets six requirements for an HCD design, where the focus when designing a system should be on the user (International Organization for Standardization, 2019).

There are several different kinds of design methodologies. User-Centered Design (UCD) represents a very similar concept within the same category as HCD. The difference between these two concepts lies in their focus. UCD directs its attention specifically towards the individual end-user of a product or service. On the other hand, Human-Centered Design (HCD) directs its attention to a broader audience in its design approach. While UCD is made to address the needs and behaviors of an end user, HCD aims to create designs that is suitable a wider range of users of the system. However, the two concepts are near-synonymous concepts (Chammas et al., 2015).

2.2.2 Cybersecurity

Another aspect of system design, that has been in the spotlight of the research in digitalization shipping for the past decade, is protection and security. As ships are becoming increasingly digitalized, and the dependence of information sharing and interconnectivity with other systems increases, so does the exposure and vulnerability to outside threats (Bolbot et al., 2020). There are no exact numbers of the frequency of cyberattacks on ships, but several incidents have been reported over the years and are expected to increase. These attacks might not only propose vast financial threats to shipowners but could also have severe impacts on safety and the environment. Resultingly, to prevent this evolution of events, multiple organizations and companies have developed guidelines and standards for the evaluation and maintenance of cybersecurity. These include IMO, BIMCO, United States Coast Guard and ISO (Bolbot et al., 2020).

2.3 The support function

The growing trend of digitalization onboard vessels, leading to the expanded use of technical tools, is often perceived positively by onboard personnel. The reason for this is partly that these technical tools make work onboard more efficient and allowing them to redirect their time towards other tasks. In a survey by ADS Insight on the increased digitization on board, 52% of seafarers thought that digital tools are user-friendly and work as they should. From the stakeholder’s point of view, this number is only 28% (Schubert et al., 2022).

2.3.1 Impact on users

Understanding how the support function affects the employee outcome is important, to make decisions and investments in support structures (Sykes, 2015). If a new system is implemented and the workers find it satisfactory, the workers are more inclined to keep using the system (Delone & McLean, 2003). When using a well working system, an employee is more efficient in comparison to an employee who does not use a company’s IT system (Engelen et al., 2022).

In addition, an employee who has high job satisfaction is more likely to be satisfied with his salary, and therefore less likely to request higher compensation (Engelen et al., 2022).

There are however possible disadvantages with technical systems. A factor related to the degree of a well working system onboard is Technostress, a term used to describe when a person struggles to handle technology well, leading to stress and discomfort in the workplace. This can happen for example when an end-user doesn't keep up with advancements in information technology. There are various reasons that contribute to technostress for the user. It impacts both an individual's personal life and job satisfaction, as well as their work and productivity (Nisafani et al., 2020). Another potential disadvantage of an ineffective technical system is that, following support, recipients may not always be informed or aware of the ultimate resolution to their issues (Allen et al., 2013).

2.3.2 Alternatives to traditional support

Technical support has historically been administered through either telephone or mail correspondence. Vessels are usually connected to the internet through a satellite connection (Maritime Insight News Network, 2021)**.** The hardware and installation process to achieve a satellite connection is generally not particularly expensive. However, the operational costs can be quite tangible. Furthermore, satellite internet is almost always slower than a land-based connection, and the connection is often not that reliable either. This since the quality of the internet connection is affected both by the position of the ship and the satellite it connects to. However, as advancements in technology and digitalization continue to evolve, alternative ways of giving and receiving technical support has been introduced.

An example of a new way of receiving support is through chatbots. A chatbot is a type of artificial intelligence that simulates a conversation with a human in the area of knowledge in which it is trained. It provides more interactive answers compared to an FAQ page, as it directly links to the question asked by the recipient of the support. It is also available all the time to provide assistance. The chatbot is often trained on data from its previous conversations. This means that it can be developed as it is used (Adamopoulou & Moussiades, 2020). Using a chatbot is also effective for the company. The number of users who in a chatbot need to contact a human representative is only 13%, which reduces the need for human personnel (Ngai et al., 2021).

However, one of the biggest disadvantages of a chatbot is its relatively frequent inability to understand what the recipient of the support wants support with. This can lead to frustration on the part of the support recipient (Adamopoulou & Moussiades, 2020). If a chatbot is unable to resolve the issue the support recipient has, the next step is typically some form of contact with a human support agent instead. However, when a user is angry and/or vague in the contact with technical support, the provider perceives it as more challenging to give support. This also results in longer resolution times for the issue at hand (Allen et al., 2013).

Another new way of working with technical support is via live video, where the recipient of the support can film what they see and show this to the support provider. This is an interactive form of support that requires a support provider to be available at the time.

Remote connection with control is another way of giving and receiving technical support. The person providing support can take control of the system used by the recipient of the support. The support can then control the system and thus identify and resolve the issue.

2.3.3 Enhancing crew training

Crew training is one of the support structures that is often started early in the process of implementing a new system. This can take place partly before the system is implemented or in an early phase, in contrast to for example a help desk that provides support when the system is used. Crew training is most often given to the crew automatically, where other support functions are given after a request from the crew after encountering an issue (Sykes, 2015). In order to ensure that an employee is satisfied with a new system, training is an important factor. The reason for this is that an employee's expectations regarding a new system will be influenced on how satisfied the employee is with the training received (Sykes, 2015). A well-trained employee in a new system will therefore also be more satisfies with the system.

There is a correlation between the degree of training and a company's devotion to IT. Companies that have a strong commitment to using IT also give their employees more training and a better quality of training (Engelen et al., 2022).

3. METHODS

The method consists of a quantitative analysis of a survey with seafarers, to provide a deeper understanding of the practical reality and the specific technical support-related problems in their working environment, and the actions taken to resolve them. The survey had questions divided into three main categories. Initially, participants were asked to identify onboard issues regarding the technical support. Subsequently, they were asked about potential solutions to those issues, including suggestions for enhancing the support systems. Finally, respondents were asked to assess the effectiveness of various options for reducing the need for technical assistance.

3.1 Data collection

Since the purpose of the report is to attempt to understand the extent of a previously identified problem, a quantitative method was used. To ensure as large of a sample as possible and to be able to perform a proper quantitative analysis, a survey was conducted to collect data for the report. It was conducted in Google Forms. The questions in the survey were based on existing literature and previous research that identified issues related to technical support onboard vessels, partly due to the increased digitalization, and possible solutions to these issues. The survey questions were divided into three main categories:

1. Questions about support related problems onboard.
2. Questions about ways to improve technical support.
3. Questions about alternatives to technical support.

Most questions were structured in a way where a certain problem / improvement / alternative was suggested, and the respondent got to grade the suggestion to collect quantitative data. The grading in the responses ranged from 1 to 5 on a scale. When it comes to the issues, a 1 indicating no problem and a 5 indicating a significant problem. Regarding suggestions for improvements, a 1 indicated no improvement and a 5 significant improvement. Lastly, regarding the questions for reducing the need for technical support, a 1 indicated no reduction and a 5 significant reduction. The survey also included a few open questions, where the respondents got to describe self-experienced support related problems and suggest other solutions than those in the grading questions, which collected qualitative data. A total of 21 questions were asked (see Appendix 1).

3.2 Demography

The survey was aimed at seafarers who either currently work or have previously worked on board ships, where they have experience working with technical systems. These systems may to some extent require technical support in the work onboard. The seafarers could work or have worked on different types of ships, including bulk carriers, oil tankers, cargo ships and passenger ships. A total of 87 responses were received.

The survey was made in two versions, one in Swedish and one in English, to ensure a maximal reach among the target group. Although the primary target group was Swedish shipping companies, it seemed like a good idea to open the opportunity for international respondents to participate, as well as making sure that international employees working onboard Swedish ships could answer the survey. 10% (9 people) answered the English survey, while 90% (78 people) answered the Swedish survey. Of the respondents, 95%, identified themselves as men, 4% as women and 1% as other.

The age distribution of the survey participants is displayed in Table 1 below, as a percentage of all respondents.

Table 1

Division of respondents (%) in age groups.

Below 18	18 - 25	26 - 35	36 - 45	46 - 55	56 - 65	Above 65
0%	10%	24%	26%	16%	22%	1%

The respondents were also asked how long experience they have in working onboard vessels and got to select one out of four different time frame options. The percentage distribution of respondents in each category can be observed in Table 2.

Table 2

Division of respondents (%) based on years working onboard ships

Less than 1	1 - 5	6 - 10	More than 10
3%	23%	10%	63%

Of the respondents, 89% stated that they were Swedish, 9% Danish and 2% Filipinos.

3.3 Selection strategy

The participants of the survey were selected through voluntary response sampling, which naturally creates some bias due to that some people might be more willing to respond than others. However, it appeared as the least biased strategy that was possible to carry out to achieve a large enough sample.

To carry out the recruitment of suitable seafarers, a link to a survey was sent via e-mail to shipping companies and asked them to kindly forward the survey to the crew on board the ships they were responsible for. This method was chosen to reach a wide range of seafarers working in different shipping companies and on different types of ships. To identify suitable shipping companies to contact, the Swedish organization Sjöfartens Utbildnings Institut (*SUI - Sjöfartens Utbildnings Institut*, n.d.) was used, which provided a summary list of shipping companies along with their contact details on their website. SUI organizes maritime education for students at, among others, Chalmers and is responsible for internship planning and collaboration with shipping companies.

3.4 Ethical concerns

In conducting our bachelor thesis research on technical support systems onboard vessels, ethical considerations regarding data collection were addressed. The main way of collecting data was as mentioned by using surveys. There are primarily four ethical perspectives to consider in international logistics, autonomy, beneficence, non-malfeasance, and justice (J. Hammer, 2017).

Regarding autonomy and consent, all participants willingly engaged in the surveys without any form of reimbursement for their time and effort. No incentives such as rewards or random prizes were offered for survey completion. From a beneficence perspective, it was therefore clear for the participants that there was no compensation provided for completing the survey, since the survey was made as a part of our thesis project at Chalmers University.

Prior to conducting the survey, participants were presented with clear information detailing the terms and conditions. This information was clearly stated in the top of the survey and could be read before answering any question. It was clearly stated that any participation was completely anonymous and confidential, and that the responses were treated with secrecy to ensure respondent privacy and confidentiality.

Confidentiality measures (non-malfeasance) were mainly done by not collecting any sensitive personal information that could potentially identify respondents. Data such as names, contact details, or company names were not requested in the survey at any point. However, demographic information such as age (within specified ranges), gender, and years of onboard experience were collected. These demographic details were necessary for data analysis purposes in order to be able to compile the data in the best way possible. Regarding justice, the introduction to the survey also specified the target responders.

3.5 Analysis

The responses from both the Swedish and English surveys were extracted to Excel, where they were combined in a single Excel sheet. The survey responses were compiled and analyzed by using a descriptive statistical method. This involved using quantitative methods to identify patterns and trends within the dataset. In addition, a content analysis of the qualitative responses was also performed. Some selected quotes from the responses were used to support and illustrate the conclusions.

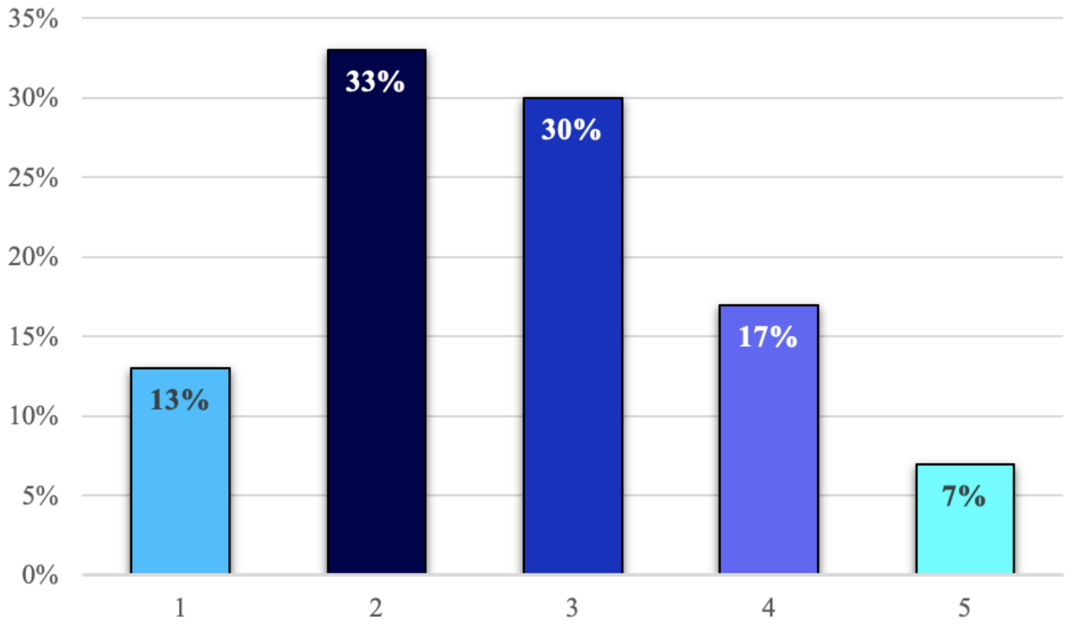
4. RESULTS

The results chapter is divided into three main parts, examining the problems, potential solutions, and alternatives to technical support at sea. Both numerical data, in the chape of the respondents' gradings of different options / phenomenon, as well as answers to more open questions are disclosed.

Firstly, the respondents got to share their general view of support. They were asked if they think technical support on vessels is an issue by and they got to grade their experience from 1 (no problem) to 5 (major problem). The average grading was 2,72 and Figure 1 presents how the answers were distributed in percentage.

Figure 1

Distribution of gradings of if support is a problem in general



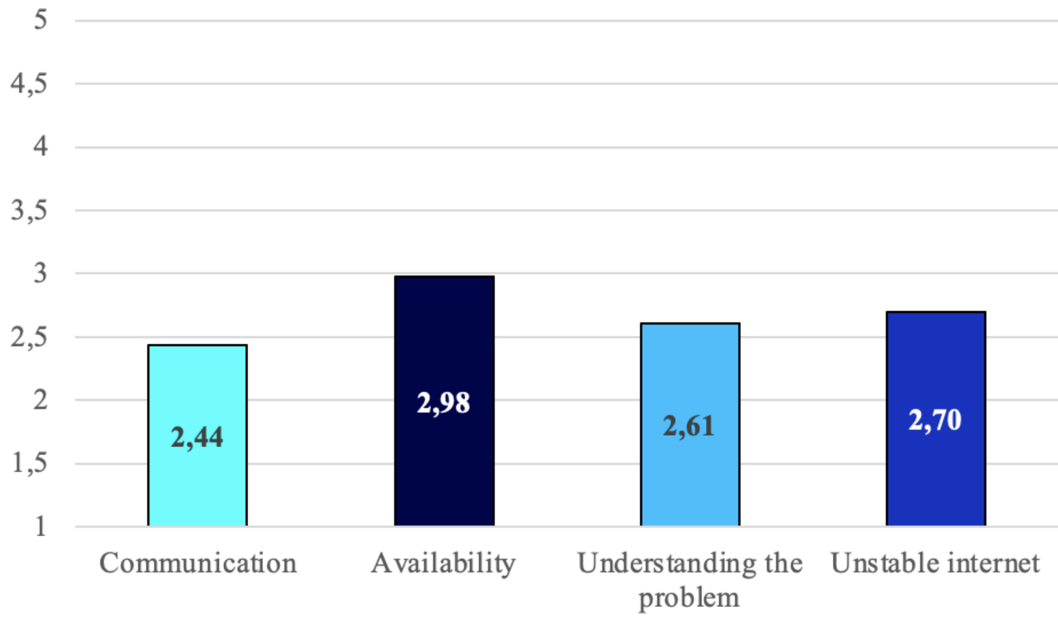
The average score differed slightly depending on the age of the respondents, but there was no linear dependence between age and the grading of the general support experience. Technical support was considered the biggest problem by respondents aged 46-55 with an average score of 3,36, and the smallest problem by those aged 56-65 with an average score of 2,37.

Respondents were also asked how they prefer to contact support, with phone, e-mail and live video calls as given options. Respondents were able to select multiple options and could add own options if they preferred to contact support in another way. Phone and e-mail were by far the most popular alternatives, chosen as preferred contact method by 76% and 70% respectively. Live video calls were less popular, only preferred by 11%. Talking face to face with the support was also mentioned as preferred contact method by 6% of the respondents.

4.1 Support related problems onboard

Figure *2*

Average gradings of support related problems



Respondents were asked to grade four previously identified problems with technical support on a scale from 1 (no problem) to 5 (major problem). As visualized in Figure 2**, s**upport being inaccessible and unavailable when needed was considered the biggest problem, with an average score of 2,98. Unstable internet preventing the access to support followed, with and average score of 2,70. Not understanding the cause of a problem and how it was resolved after receiving support got an average problem grading of 2.61. Communication with support and difficulties in understanding each other was considered the smallest problem by the respondents, with a score of 2,44. In Table 3**,** the percentage of respondents that answered a certain grade for each problem can be observed.

Table 3

Distribution of gradings of support related problems

	1	**2**	**3**	**4**	**5**
Communication	21%	38%	22%	16%	3%
Accessibility	14%	21%	32%	21%	13%
Understanding the problem	15%	30%	39%	11%	5%
Unstable internet	22%	25%	23%	21%	9%

The respondents were also asked whether they had encountered any additional support-related issues beyond those already outlined in the questionnaire in the previous questions. The question was answered in an open text field. Several recurring trends in the responses were identified:

Competence of the support providers
One recurring theme was the lack of knowledge and competence from the support giving personnel and system. It was mentioned that the support giver might be unaware of how the technology on board is used, and also that they lack knowledge in areas that they are expected to be familiar with when contacted by onboard personnel. Depending on the skills of the giver of the support, there is a significant variation in the perceived quality of the support received.

Language issues

Also, within the same theme of lack of knowledge on the part of the support personnel, are breakdowns in communication due to the language barrier. It is brought up multiple times that there sometimes is a language problem when contacting technical support. Depending on whom the support is given from, there is sometimes a problem when the support is provided from countries such as India, or elsewhere, where support might be outsourced, leading to the support given not being understood by the receiver onboard.

"When phoning support, they operate from a street in Mumbai."

Response time

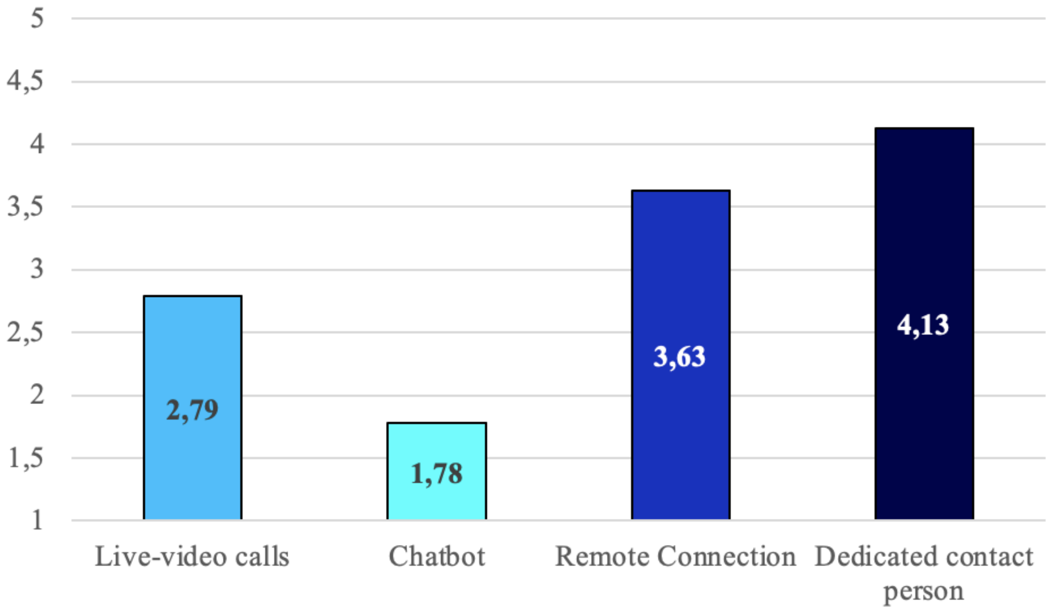
The lack of follow-up from the support personnel together with lengthy response times is another recurring issue in the survey that is highlighted by several respondents. Receiving a response after contacting the support can take a considerable amount of time. The delays in receiving support, when for example sending an email, was mentioned several times. Respondents have noted that those issues can be perceived as even more pronounced when the situation requiring technical support is urgent, or during holidays. Furthermore, respondents have reported instances where they have not received an answer to the technical support request at all.

4.2 Improved technical support

The participants of the survey were asked what they thought of four different ways of receiving technical support, mentioned in previous research. Respondents got to grade the potential improvement to the technical support of these on a scale from 1 (no improvement) to 5 (significant improvement). Participants were also asked in an open question whether they had any other suggestions for improving technical support, for example other technologies or methods.

Figure *3*

Average gradings of ways to improve support



As visualized in Figure 3**,** having a dedicated contact person at the support company was the preferred solution to improving technical support of the above, with an average grading of 4,13. Remote connection with control, allowing support personnel to manually take control over and manage systems, was considered the second-best option with a score of 3,63. Live video calls were less popular, with a score of 2,79. The option of using a chatbot for support was considered the worst solution, with an average grading of 1,78. The percentage distribution of grades for each of the suggested solutions are displayed in Table 4 below.

Table 4

Distribution of gradings of ways to improve support.

	1	**2**	**3**	**4**	**5**
Live video calls	21%	21%	29%	18%	11%
Chatbot	60%	13%	18%	8%	1%
Remote connection	8%	10%	22%	30%	30%
Dedicated contact person	5%	5%	14%	28%	49%

Strategies to manage without support available

In the survey, respondents were asked about how they handle situations in which they are unable to reach technical support. The question was answered in an open text field, and a couple of trends were noticeable.

Based on the responses provided, one main finding was evident. When onboard personnel are unable to reach technical support, they often try to handle the issue or problem themselves. Using temporary solutions was often mentioned, as well as different work arounds. Of the total number of answers to the open question, 70% consists of answers where individuals mentioned that they try to solve the problem on their own. Primarily to avoid the vessel from standing still. So, when unable to reach technical support, individuals on board ships typically try to resolve the issue independently to the best of their ability. They try to find temporary solutions or workarounds while relying on all the available recourses that can be found onboard the vessel. The temporary solutions are often created through trial and error, or by consulting available manuals.

"We who work at sea are exceptionally skilled at solving problems independently."

It is also frequently mentioned in the responses that individuals seek assistance from colleagues on board to solve a problem. This is done by collaborating to find a solution if technical support cannot be reached. It is also commonly mentioned by the responders that waiting with addressing the issue or postponing the contact with support until is available can be an option.

Survey respondents were asked about if they had any potential recommendations for enhancing the technical support aboard ships, such as alternative technologies or methods for accessing and / or receiving support (Figure 4). The answers to the question varied widely, each answer often occurring only once as a response.

In the survey, it is however noted multiple times in the open question text fields, that what would have improved the technical support is if the support function were more competent and trained. The person providing support should have a strong understanding of the onboard systems being used by the onboard personnel.

"An accessible, competent, and dedicated technical support within the shipping company."

4.3 Decreased demand for support

Finally, the survey respondents were asked to grade three different ways of potentially reducing the need for technical support in the first place, from 1 (no reduction) and 5 (significant reduction). The average gradings are presented in Figure 4 below. The best way of reducing need for support, according to the respondents, is that the technical systems are designed to be more user-friendly, with an average score of 4,05. Increasing training in the onboard systems for the onboard personnel got a score of 3,69. The least preferred option, to have guidance / wizards built into the systems used, was graded 3,15 on average. Table 5 displays the percentage distribution of grades for each alternative above.

Figure 4

Average gradings of alternatives to technical support.

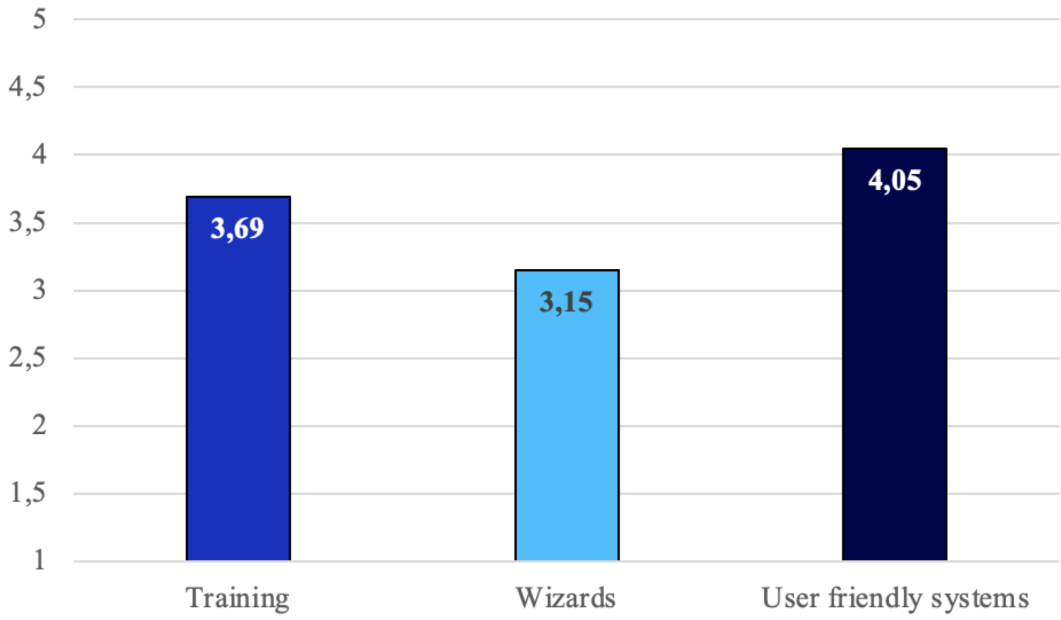


Table 5

Distribution of gradings of alternatives to technical support.

	1	2	3	4	5
Training	3%	9%	31%	28%	29%
Wizards	10%	13%	38%	30%	9%
User friendly systems	1%	3%	25%	30%	40%

5. DISCUSSION

In this chapter, the meaning of some of the results is discussed in relation to the theory chapter. The purpose is to analyze the results in the context of the theoretical background.

5.1. Is it a problem?

Despite previous research by Lundh et al. (2023) indicating that technical support at sea is a big problem, this study did not confirm that statement. The general support experience was ranked closer to no problem than a major problem. The same goes for the more specific support related problems, that all were considered fairly minor problems. In terms of factors affecting the results, one might be that the age distribution of the participants was slightly skewed towards the younger side, with a 60/40 ratio of participants below/above 45 years old. Another is that over 60% of the participants had more than 10 years of work experience and, hypothetically, don't need as much support as seafarers with less experience. With that in mind, there is no getting around the fact that based on this study, technical support at sea is not a major problem.

5.2. Traditional preferences

This study made it very clear that the communication technology and the way support is traditionally received, is not considered a support related problem. Phone and email were by far the most preferred ways of communicating with the support, while more modern technology such as live video calls, wizards, and particularly chatbots were rejected. This could potentially be a consequence of the infrequent experience of interacting with a bot compared to a human, brought up by Adamopoulou and Moussiades (2020).

What most seafarers thought would have the biggest positive impact on the support function is a dedicated contact person at the company giving support. Taking this into consideration, in addition to that availability is considered the biggest support related problem and that there were numerous complains about the competence of those giving support, it further indicates that outdated technology is not the problem. If shipowners or supporting companies want to improve the technical support given to seafarers, they should rather look at improving service and acquiring competence closer to those working at sea. This could help bridge the gap of WAI and WAD described by Wears and Hollnagel (2017). But of course, it goes the other way around as well, and WAD and WAI are ideally adjusted simultaneously (Wears & Hollnagel, 2017). If seafarers better understand the digital technology in their working environment, having a productive conversation with the support might get easier. After all, enhanced crew training was considered a quite good way of reducing the need for support in this study.

5.3. User friendliness

In the study we asked about ways to decrease the need for technical support. One way to do this according to the responders is to increase the user friendliness of the system, a solution that was clearly shown to be the most important and crucial. Enhancing the user friendliness of the systems can be achieved by implementing a design philosophy that aligns with the concept of UCD, User Centered Design. This means designing the systems with needs and behaviors of the individual end-user in focus (Chammas et al., 2015). A system with a better user friendliness and overall usability can then be reached. The design can receive an ISO certification for HCD (International Organization for Standardization, 2019).

By adopting a UCD approach when designing the systems not only the usability will improve, but it also in some extent helps mitigate the risks involved with improvised solutions by the onboard personnel. As indicated in the results, one of the most used solutions by the onboard personnel when technical support cannot be reached, is to try to solve the issue without the support function. This is done by utilizing their own knowledge and the available recourses onboard. However, this independent troubleshooting comes with risks.

When the onboard personnel come up with their own solutions to issues onboard, there is a potential risk of triggering a domino-effect of new issues from those solutions. The initial problem-solving attempt can lead to further issues with the system, and unintended consequences with the systems onboard. For example, the creative solutions made up by the onboard personnel to address an issue might not adhere to the standard procedures or manuals. Consequently, this can then cause issues and difficulties for the support function to rectify since the system does not look or work as intended. This could also make communication with support increasingly difficult, leading to extended downtime or worsening of the initial problem.

5.4. Methods discussion

Since the purpose of the study is to understand the scope of support related problems and what solutions are preferred by seafarers, a survey was likely the most appropriate method. The data that was needed to answer the questions was primarily quantitative. Interviews, for instance, could have provided more context of certain problems and solutions as well as potentially bringing up additional ones. However, achieving a large enough sample to be able to define characteristics of seafarers in general, which is the aim of the study, would not have been possible with interviews.

In terms of validity, the survey could have been improved to some extent. No questions were asked about the IT knowledge and experience of the respondents. A skewness in either direction could potentially have impacted the results. Furthermore, no questions were asked about the positions of the respondents. This could have been relevant to include in the results in case there is a big difference in the perception of the support experience depending on work position. As previously mentioned, the age distribution of the respondents was also slightly skewed towards the younger side, which might have impacted the results. However, based on this sample, no linear patterns between age and the perception of if technical support is a problem could be noted.

In the survey, data was collected by reaching out to shipping agencies to get direct insights from the onboard personnel. If the survey were to be repeated using the same method of contacting respondents, it is likely that the findings would remain consistent if it would have involved the same group again. This showcases the reliability of the findings.

6. CONCLUSION AND RECOMMENDATIONS

This study shines a light on multiple problems regarding IT support experienced by seafarers, including long response times, language barriers and insufficient competence. Despite room for improvements however, the study concludes that technical support at sea in general not is major issue. The same applies for more specific problems identified in previous research. In terms of improving technical support, seafarers are generally skeptical towards doing so by introducing new technology. They would rather prefer improvements to the current support structure when it comes to availability and competence, and having a dedicated contact person at the support company could have a major positive impact on the support experience. Digital systems at ships being designed with the users in mind to a larger extent could also lead to big improvements.

In future research, it could be interesting to examine how to better organize the technical support function for seafarers. This could involve investigating further how a designated contact person for support would improve the support function, as outlined in this report. The current system, with multiple point of contacts, is not sustainable in the long run and can cause frustration and confusion for the seafarers. In a future with an even more increased digitalization and automatization onboard ships, together with reduced manning, the support function is becoming an increasingly important part of the work.

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APPENDIX 1 - SURVEY

Technical support onboard vessels

This survey is a part of our thesis project, where we examine how technical support works onboard vessels.

The survey takes approximately 5-8 minutes to complete.
.
This survey is aimed at individuals who have experience working onboard ships and have interacted with technical systems in some capacity.

Your participation in this survey is completely anonymous and confidential. Your responses will be treated with confidentiality, and no one will be able to identify you through them. Thank you for your trust and participation.

Arvid Andersson and Samuel Svedlund
International Logistics, Chalmers University of Technology

* Indicates required question

1. Which age group do you belong to? *
    - Under 18
    - 18 – 25
    - 26 – 35
    - 36 – 45
    - 46 – 55
    - 56 – 65
    - Over 65
    - Prefer not to disclose
2. Which gender do you identify with? *
    - Male
    - Female
    - Other
3. What is your nationality? *
    - (Open text field)
4. How many years of experience do you have working onboard ships? *
    - Less than 1
    - 1- 5
    - 6 – 10
    - More than 10

5. Do you experience inadequate technical support as an issue onboard? *
    - (No problem) 1 – 2 – 3 – 4 – 5 (Major problem)

6. How do you prefer to contact technical support? *
    - Phone
    - Email
    - Live video call
    - Other: (Open text field)

Do you perceive the following as an issue onboard?

7. Communication with support *

   (for example, difficulties in understanding each other, different terminology)

    - (No problem) 1 – 2 – 3 – 4 – 5 (Major problem)

8. Support is not available when needed *

   (for example, nighttime, outside of office hours)

    - (No problem) 1 – 2 – 3 – 4 – 5 (Major problem)

9. Difficulty understanding the cause of the problem or how it was * resolved after receiving support *

    - (No problem) 1 – 2 – 3 – 4 – 5 (Major problem)

10. Unstable internet connection prevents accessing support *

    - (No problem) 1 – 2 – 3 – 4 – 5 (Major problem)

11. Rank the problems from (1) greatest problem to (4) least problem: *
    - Communication: 1 – 2 – 3 – 4
    - Availability: 1 – 2 – 3 – 4
    - Understanding of the problem: 1 – 2 – 3 – 4
    - Unstable internet: 1 – 2 – 3 – 4

12. Have you experienced any other support-related issues?
    - (Open text field)

13. How do you handle the situation if you cannot reach technical support?
    - (Open text field)

Do you believe the following would improve technical support?

14. The option to use a live video call *

    - (No improvement) 1 – 2 – 3 – 4 – 5 (Significant improvement)

15. The option to use a chatbot *

    - (No improvement) 1 – 2 – 3 – 4 – 5 (Significant improvement)

16. The option to use "Remote Connection with control" *

(Remote control where support personnel remotely take control and manage systems)

- (No improvement) 1 – 2 – 3 – 4 – 5 (Significant improvement)

17. Having a dedicated contact person at the support company *
    - (No improvement) 1 – 2 – 3 – 4 – 5 (Significant improvement)

18. Are there any improvement suggestions you would like to share regarding technical support onboard ships? (e.g., other technologies or methods)
    - (Open text field)

Do you believe the following would reduce the need for technical support?

19. Increased training in the onboard systems *
    - (No reduction) 1 – 2 – 3 – 4 – 5 (Significant reduction)

20. Guidance / "wizards" providing answers to questions are built into the systems used *
    - (No reduction) 1 – 2 – 3 – 4 – 5 (Significant reduction)

21. The systems are designed to be more user-friendly *
    - (No reduction) 1 – 2 – 3 – 4 – 5 (Significant reduction)

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