

# Navigating Change: The Role of 21st Century Technological Innovations on Seafarers' Professional Lives

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## ABSTRACT

The research investigated the impact of modern technology on seafarers within the maritime industry, aiming to understand how technological advancements influence their work lives through a narrative phenomenology qualitative research approach. The findings revealed a significant transformation in seafarers' professional experiences, identifying key themes such as automation, communication evolution, continuous training, enhanced maintenance, and improved emergency response. Seafarers reported positive attitudes towards the efficiency brought by automation, while communication technologies provided global connectivity but raised concerns about constant updates. Job satisfaction was shaped by diverse roles, adaptation challenges, productivity gains, and career advancement opportunities. Continuous learning emerged as essential, underscoring the need for seafarers to stay current with evolving technologies. Adaptation strategies included developing soft skills, complying with regulations, and anticipating future trends. Recommendations emphasized continuous learning, effective time management for internet use, upgrading educational institutions, specific equipment training, and proficiency in software applications. These recommendations offer a roadmap for seafarers, educational institutions, and industry stakeholders to navigate and leverage technological advancements in the maritime sector, ensuring safety, satisfaction, and success amid ongoing technological evolution.

## INTRODUCTION

According to Bowdich (2002), new technologies similarly influenced the job of a navigator. Seafarers regularly practiced navigation using celestial bodies (sun, stars, and planetary bodies) and sextants. Seafarers were also expected to know the names of all major stars and constellations by heart. The advent of the Global Positioning System (GPS), followed by its mandatory implementation on merchant ships, revolutionized navigation. Instead of relying on the traditional skills and cumbersome calculation of sextant and celestial navigation, the new GPS technology offered a "happy-click-button" navigation on ships (Soundings, 2009). Navigation became simpler and safer as the GPS provided far more accurate ship positions. But as seafarers progressed through the ranks, some experience discouragement from using electronic equipment excessively during navigation. As a "fair weather practice" at sea, seafarers are always encouraged to practice traditional navigation skills.

Over time, the worldwide maritime automated distress and safety system—a computerized system intended to increase safety—was implemented (IMO, 2009). The use of radio communication devices and officers was subsequently phased out on ships. to share the radio officer's duties. With the introduction of unmanned machinery spaces, the engine workforce in the engine room was reduced. It was no longer necessary to have a competent engineer present at all times in the machinery and engine rooms. Any fault or abnormality might be reported as an engine alarm to the engineer's lodging after the machinery compartments were locked at night (Ships Business, 2022).

In terms of trade and transportation, the maritime sector is essential, acting as a lifeline for the world economy. The maritime industry has seen a considerable transformation as a result of technical improvements throughout the years. The sector has seen several changes as a result of the introduction of new technologies like automation, digitization, and the Internet, which are projected to improve efficiency, safety, and cost-effectiveness

(Mckinzsey, 2021). It's crucial to comprehend the effects these innovations will have on seafarers' careers in addition to these improvements.

Technological innovations have brought about significant changes in various industries, including the maritime industry. These innovations have the potential to transform seafarers' professional lives, impacting their work environment, job responsibilities, skill requirements, job satisfaction, and overall well-being. However, the implications of these 21<sup>st</sup> century technological advancements on seafarers' professional lives in the maritime industry have not been extensively explored.

Generally, this study aims to investigate the implications of 21<sup>st</sup> century technological innovations on seafarers' professional lives.

Specifically, this study aims to answer the following questions:

1. What are the changes in job responsibilities and skill requirements for seafarers resulting from 21<sup>st</sup> century technological innovations on board the ship?
2. How do technological innovations influence seafarers' job satisfaction in the maritime industry?
3. What are the adaptation strategies seafarers employed in addressing the challenges posed by technological innovations?

## **METHODOLOGY**

The research was qualitative in nature and employed a narrative phenomenological inquiry approach using a semi-structured questionnaire to examine the impact of 21<sup>st</sup>-century technological innovations on the professional lives of seafarers onboard ships.

The study encompassed the following aspects: technological innovations prevalent in the maritime industry, including but not limited to automation, robotics, the Internet of Things (IoT), artificial intelligence (AI), and data analytics; the impact of these technological innovations on seafarers' professional lives, including work environment, job responsibilities, skill requirements, job satisfaction, and overall well-being; and the adaptation strategies employed by seafarers to cope with the challenges and changes brought about by technological innovations in their professional roles and responsibilities.

The semi-structured questionnaire was subjected to validation by experts and approved by the research adviser. The respondents of this study were five (5) deck seafarers employed in various shipping companies, selected through convenience random sampling. The collected data were analyzed using thematic analysis.

Prior to beginning the survey, respondents were given an informed consent form that guaranteed their anonymity and confidentiality. This study was conducted during the first semester of the academic year 2023-2024.

The respondents of this study were five seafarers from the deck department employed in various shipping companies, selected through convenience random sampling. To qualify as respondents, they needed at least three years of international sea experience, regardless of rank and department. The respondents consisted of five male seafarers aged 28 to 48 years. Among them, three were second officers and two were either master or chief mate. All respondents were married and had between 8 and 23 years of sea service experience. They served on tankers, container ships, bulk carriers, and general cargo ships.

To obtain the appropriate data, the researchers utilized a semi-structured questionnaire during interviews, conducted either online or face-to-face. Part I of the questionnaire addressed the demographic profile of the respondents, determining their age, sex, civil status, department, rank, and length of service. Part II sought answers about the implications of technological innovation on their professional lives.

An interview protocol was used for asking questions and recording answers during the qualitative interviews. The protocol included the following components: (1) heading (date, place, interviewer, and interviewee); (2) instructions for the interviewer to ensure a standard procedure across interviews; (3) questions (starting with an ice breaker, followed by sub-questions in a qualitative research plan, and concluding statements or questions); (4) probes for questions to encourage detailed explanations; (5) space between questions for recording responses; and (6) a concluding statement to acknowledge the interviewee's time. Information and data from the interviews were rec the study's objectives, the researchers initially drafted questions to ensure their relevance to the study. This draft was reviewed by a panel of experts, and their corrections and suggestions were incorporated into the final interview guide.

The researchers conducted online interviews via Google Meet and Facebook Messenger or face-to-face using the semi-structured questionnaire. This approach combined predetermined open-ended questions with opportunities for the interviewer to explore specific themes or responses further. The potential respondents were informed about the nature and purpose of the research, the procedures to be used, the expected benefits, potential risks, stress, and discomfort, and the alternatives to participation. They were asked to fill out an informed consent form written in lay language, avoiding technical terminology. The respondents had the chance to ask questions to better understand the research purpose. The gathered data were encoded and interpreted using narrative phenomenological inquiry analysis and thematic analysis.

Ethical considerations included upholding human subject principles, obtaining informed consent, and weighing benefits and risks. The consent form explained the study, the rights and protection of respondents, and the option to decline specific questions or withdraw from the interview at any time. At the start of each interview, the researcher explained the study's purpose and interpreted the informed consent form. The respondents signed the consent form and received a copy. They were assured that their answers would be treated with utmost confidentiality and used solely for research purposes. They could also withdraw from participation at any time.

During the interview, participants were informed that they could take rest breaks to avoid physical discomfort. To maintain anonymity and privacy, last names were not used; instead, initials were utilized in transcripts and references. At the study's conclusion, recorded interviews, field notes, and documented narratives were kept securely by the researcher.

Thematic analysis, as proposed by Braun and Clarke (2006), was used to analyze the qualitative data. This method involved identifying patterns, themes, and recurring ideas within the data. Braun and Clarke's six-step process provided a structured approach for analyzing data and generating meaningful themes. The process began with familiarization with the data, followed by the generation of initial codes, labeling meaningful units to capture key aspects and patterns. Researchers then searched for themes by reviewing and organizing the initial codes, identifying similarities and differences across the dataset. The identified themes were thoroughly reviewed and refined, ensuring relevance and coherence with the research objectives. Clear and concise definitions and labels were provided for each theme. Finally, the findings were compiled, presenting a comprehensive analysis supported by quotes or examples from the transcription.

This thematic analysis method offered a flexible and accessible approach to uncover meaningful patterns and themes, guiding the researchers in analyzing the data gathered. This approach aimed to produce accurate and valid data, helping to gain a deep understanding of the implications of 21st-century technological innovation on the professional lives of seafarers.

## RESULTS AND DISCUSSION

### **Theme 1:** Advancements in Technology Transforming Seafarers' Professional Lives

The implications of technological innovations on seafarers' professional lives are multi-faceted, encompassing task automation, communication evolution, continuous training, enhanced maintenance, and improved emergency response and safety measures. The respondents' statements provide valuable insights into the transformative effects of technology in the maritime industry.

The transformation in seafarers' professional lives due to technological advancements aligns with the changing landscape of the maritime industry discussed in related studies. The push for innovation, collaboration with external entities, and the need for efficiency, safety, and environmental protection are consistent themes across both the respondents' perspectives and the broader maritime industry context outlined in the studies. The discussions on autonomous operations and alternative marine fuels further highlight the ongoing paradigm shift in the industry, emphasizing the necessity for communication and coordination among stakeholders for successful integration of these technological advancements.

### **Subtheme 1.1: Automation Simplifying Seafaring Tasks**

The respondents emphasize the significant impact of technological innovations on seafarers, particularly the automation of various tasks. Participant 2 highlights the shift from manual procedures to automation in functions such as loading, navigation, voyage planning, communication, and data collection. This transition has led to a considerable ease in performing duties, with technology handling previously manual processes. Statements like "making our lives much easier," "tasks are now much easier," and "the process is automated, making updates quick and efficient" from respondents 2 and 3 underline the positive transformation automation has brought to seafarers' professional lives.

Technological advancements, particularly in the automation of tasks, have significantly impacted seafarers' professional lives. This subtheme aligns with studies that highlight the traditional resistance to innovation in the maritime industry (Jenssen and Randøy, 2002; Doloreux and Malançon, 2008). The resistance is attributed to high development costs and strict regulations. However, the need for increased efficiency, safety, and environmental protection is recognized as a driving force for embracing innovation (Blakely, 2007). This subtheme corroborates the evolving trend in the industry towards embracing automation to enhance operational efficiency.

### **Subtheme 2.2: Evolution of Communication Technologies**

The evolution of communication technologies emerges as another subtheme. Participant 3 and Participant 4 emphasize the transformative impact of technology on communication. The integration of satellite internet, GPS, and advanced communication tools allows seafarers to connect with their families and offices globally. The statements "communication has become highly advanced now," and "you can communicate with your family and your office from anywhere" illustrate how technology has revolutionized communication at sea. However, Participant 5 also notes the pressure associated with constant updates and monitoring facilitated by technology, pointing to a potential downside.

The evolution of communication technologies in the maritime industry aligns with the broader perspective presented in the related studies. The demand for collaboration with other maritime organizations and entities outside the industry for innovation (Jenssen, 2003) resonates with the statements about advanced communication tools enabling global connectivity for seafarers. However, the potential downside mentioned by Participant 5, regarding the pressure associated with constant updates, reflects the challenges of adapting to rapid technological changes, which is also recognized in the studies emphasizing the importance of continuous training and skill development.

### **Subtheme 1.3: Continuous Training and Skill Development**

Continuous training and skill development constitute a crucial subtheme in the context of technological advancements. Respondents 3, 4, and 5 stress the importance of being tech-savvy and proficient in computer-based skills. Statements such as "training is continuous," "seafarers should be techy," and "familiarization or additional in-house training" underscore the ongoing need for seafarers to adapt to new technologies through continuous learning. The ability to operate software tools like "Excel, Word, and PowerPoint" is highlighted as a key advantage for seafarers in modern ships, emphasizing the changing skill set required in the maritime industry. Continuous training and skill development emerge as a critical subtheme, resonating with the related studies emphasizing the necessity for collaboration with science and businesses to facilitate research and development (Blakely, 2007; Doloreux and Malançon, 2009). The respondents stress the importance of being

tech-savvy and proficient in computer-based skills, reflecting the changing skill set required in the maritime industry. This aligns with the notion that ongoing training and adaptability are essential for seafarers to keep pace with technological advancements.

#### **Subtheme 1.4: Enhanced Maintenance and Troubleshooting**

Technological innovations have also revolutionized maintenance and troubleshooting processes on ships. Participant 2 and Participant 3 discuss how advanced technology enables remote monitoring, digital diagnosis, and online applications for maintenance. Statements like "troubleshooting is much easier compared to the technology that we had before" and "you can immediately determine the problem with a particular piece of equipment" emphasize the efficiency and ease brought about by technology in addressing maintenance issues.

The subtheme of enhanced maintenance and troubleshooting aligns with the related studies that discuss the need for innovation to improve efficiency and safety (Blakely, 2007). The respondents highlight how advanced technology enables remote monitoring, digital diagnosis, and online applications for maintenance. This resonates with the broader perspective of the industry shifting towards innovation to address challenges related to maintenance and troubleshooting efficiently.

#### **Subtheme 1.5: Impact on Emergency Response and Safety**

The theme extends to the impact of technological innovation on emergency response and safety at sea. Respondents 2, 3, and 4 discuss how real-time data, GPS, and advanced monitoring systems have transformed emergency communication. Statements like "real-time position and speed of the vessel," "a simple click can notify others that the vessel is in distress," and "advanced equipment can easily determine emergencies" highlight the safety advantages offered by technology. However, concerns about GPS reliability in high-risk areas, as mentioned by Participant 3, introduce a distinction on the role of technology in ensuring safety.

The impact of technological innovation on emergency response and safety aligns with the studies emphasizing the industry's need to improve safety and reduce emissions (Porathe et al., 2014). The use of real-time data, GPS, and advanced monitoring systems for emergency communication reflects the industry's commitment to embracing technology for enhancing safety measures. However, concerns about GPS reliability in high-risk areas introduce a different perspective, underlining the importance of addressing potential challenges associated with technological reliance.

### **Theme 2: Impact of Technological Innovations on Seafarers' Job Satisfaction**

The influence of technological innovations on seafarers' job satisfaction is a complex interplay of diverse job roles, productivity gains, career advancement, continuous learning, and challenges and opportunities associated with handling advanced technology. The respondents' insights provide a nuanced understanding of the multifaceted impact of technology in the maritime industry.

The emphasis on the historical context of maritime innovation, the emergence of autonomous vessels, and the importance of collaborative efforts between science and businesses is crucial for successful innovation.

#### **Subtheme 2.1: Diverse Job Roles and Challenges in Adaptation**

The respondents highlight the diverse impact of technological innovations on seafarers' job roles and job satisfaction. Participant 2 notes that "technological innovation has led to more diverse job roles, expanding responsibilities beyond traditional tasks such as voyage planning and navigation". However, the challenge arises as seafarers, like Participant 2, who may not be naturally inclined towards technology, "feel a regression in performance and job satisfaction". All of the respondents emphasized the struggle in learning and adapting to new equipment, leading to decreased job satisfaction despite the potential benefits of making work easier.

The respondents express the diverse impact of technological innovations on seafarers' job roles and job satisfaction, highlighting the expansion of responsibilities beyond traditional tasks. This resonates with studies



that suggest the maritime industry has traditionally been less open to innovation due to high development costs and strict regulations (Jenssen & Randøy, 2002; Doloreux & Malançon, 2008). The challenges faced by seafarers in adapting to technology align with the idea that explicit strategies and collaborative efforts are needed to foster innovation in the industry (Blakely, 2007).

### **Subtheme 2.2: Productivity, Safety, and Profitability Gains**

The respondents also discuss the positive impact of technological innovation on productivity, safety awareness, and profitability in the maritime industry. Participant 4 highlights that, “advancements in technology increase productivity, enhance safety awareness, and contribute to additional profits for the company”. The reduction in accidents and incidents leads to lower insurance claims, thereby maintaining stable premiums. This subtheme underscores how technology can bring tangible benefits to both seafarers and companies, potentially contributing to job satisfaction through improved working conditions and financial stability.

The positive impact of technological innovation on productivity, safety awareness, and profitability is emphasized by respondents, aligning with the current trend recognizing the need for innovation to achieve efficiency and safety in the maritime industry (Blakely, 2007). The respondents' insights resonate with the notion that collaboration between science and businesses is crucial for successful innovation and the adoption of advances in research and development (Vivero, 2007).

### **Subtheme 2.3: Career Advancement and Opportunities**

Technological innovations have reshaped career paths and opportunities for seafarers. Participant 3 notes that, “as technology advances, younger officers are becoming more prevalent, and the industry is becoming more oriented towards the latest technologies”. The integration of computerized tasks and increased reliance on technology provides opportunities for career progression. Participant 4 further emphasizes “that technology has made job applications more accessible, with online platforms facilitating convenient application processes.” These advancements offer new career paths and opportunities, contributing to job satisfaction through enhanced accessibility and diversification of career options.

Technological innovations reshape career paths, making younger officers more prevalent, aligning with the industry becoming more oriented towards the latest technologies.

This corresponds with the idea that innovation leads to new career opportunities and paths (Jenssen, 2003). The accessibility of job applications through online platforms, as mentioned by respondents, aligns with the belief that collaboration and openness to innovation are key for advancement in the maritime industry (Doloreux & Malançon, 2009).

### **Subtheme 2.4: Continuous Learning and Adaptation**

The theme of continuous learning and adaptation emerges as seafarers discuss the challenges and opportunities associated with technological innovation. Participant 2 acknowledges that the rapid changes in technology pose a challenge for seafarers who are not naturally inclined towards it. Participant 5 emphasizes the “need for continuous training and familiarization to keep seafarers updated with new equipment and technologies”. The respondents highlight the importance of staying updated to avoid feeling outdated in the rapidly evolving technological landscape, indicating that a proactive approach to learning is crucial for maintaining job satisfaction.

The theme of continuous learning and adaptation aligns with the challenges posed by rapid technological changes. Respondents' acknowledgment of the need for continuous training corresponds with studies emphasizing the importance of staying updated to address challenges in the evolving technological landscape (Perunovic Z., 2011).

### **Subtheme 2.5: Challenges and Opportunities in Handling Advanced Technology**

Respondents discuss both “challenges and opportunities in handling advanced technology”. Challenges include

according to respondents 2 and 4 include, “unfamiliarity with new equipment, potential regression in job satisfaction, and the need for seafarers to work harder to keep up with technological advancements”. However, “opportunities arise in terms of enhanced training with additional computer-based modules, improved safety through real-time monitoring, and the convenience of remote work” as highlighted by Participant 1. The respondents' perspectives illustrate the dual nature of technological innovation, where challenges must be addressed for seafarers to fully realize the benefits and opportunities offered by advanced technology.

The dual nature of technological innovation, with both challenges and opportunities, is highlighted by respondents. This aligns with the concept that the maritime industry is at a turning point, with autonomous shipping being a potential paradigm shift, requiring cooperation and coordination among stakeholders (Burmeister et al., 2014).

### **Theme 3: Adaptation Strategies Employed by Seafarers in Addressing Technological Innovation Challenges**

The adaptation strategies employed by seafarers in response to technological innovation challenges encompass a multidimensional approach. This includes the cultivation of soft skills, continuous learning through specialized training, familiarity with technology, compliance with regulations, and the anticipation of future trends. The combination of these strategies reflects the dynamic nature of the maritime industry and the proactive stance taken by seafarers to thrive in an environment of technological evolution.

#### **Subtheme 3.1: Soft Skills and Mindset for Resilience and Adaptability**

The respondents stress the significance of soft skills and a resilient mindset as crucial adaptation strategies for seafarers facing technological changes. Participant 2 emphasizes the “importance of resiliency, adaptability, and various soft skills, including cognitive intelligence, emotional intelligence, and teamwork”. These qualities are deemed essential for seafarers to navigate through the challenges posed by technological advancements. The focus on soft skills suggests that alongside technical proficiency, psychological and interpersonal skills play a pivotal role in addressing the impact of technological innovations.

The emphasis on soft skills and a resilient mindset as vital adaptation strategies aligns with existing literature on the importance of adaptability in the maritime industry (Stateczny, 2019). Participant 2's stress on "resiliency, adaptability, and various soft skills, including cognitive and emotional intelligence, is consistent with the understanding that alongside technical proficiency, psychological and interpersonal skills are pivotal in addressing the impact of technological innovations (Stateczny, 2019).

#### **Subtheme 3.2: Continuous Learning and Specialized Training**

Continuous learning and specialized training emerge as key strategies employed by seafarers to cope with technological innovation challenges. Respondents highlight the “need for seafarers to enroll in different training programs, familiarize themselves with new technologies, and undergo specialized training for specific equipment and tasks.” This proactive approach to education ensures that seafarers stay abreast of the latest advancements and acquire the necessary skills to operate advanced technologies effectively. The emphasis on specialized training underscores the industry's recognition of the need for targeted education to address specific challenges associated with evolving technologies.

The recognition of continuous learning and specialized training as key strategies corresponds to the broader industry acknowledgment of the need for targeted education to address specific challenges associated with evolving technologies (Jenssen and Randøy, 2002). Respondents' emphasis on enrolling in different training programs, familiarizing themselves with new technologies, and undergoing specialized training aligns with the industry's shift towards more innovation-driven activities for increased efficiency and safety (Blakely, 2007; Jenssen, 2003).

#### **Subtheme 3.3: Familiarity and Expertise in Handling Technology**

The importance of familiarity and expertise is highlighted by Participant 4, who concisely notes that, “dealing

with technological challenges is a matter of being familiar and having expertise”. This indicates that a deep understanding of the technology at hand is crucial for seafarers to effectively navigate the challenges posed by new equipment and innovations. The subtheme underscores the significance of proficiency and hands-on experience in mitigating potential issues associated with advanced technologies.

The acknowledgment of the importance of familiarity and expertise aligns with literature highlighting the necessity of advanced and sophisticated management systems for unmanned vessels (Stateczny, 2019). Participant 4's statement that dealing with technological challenges is a matter of being familiar and having expertise underlines the crucial role of proficiency and hands-on experience in navigating challenges posed by advanced technologies (Stateczny, 2019).

### **Subtheme 3.4: Compliance with Regulations and Updated Certifications**

All the respondents stress “the need for seafarers to comply with regulations, undergo required training, and keep certifications updated.” This subtheme focuses on the regulatory aspect of adaptation, indicating that adherence to industry standards and certifications is a fundamental strategy for seafarers. Participant 3 stated that, “So, pag, angpag-interact namansabagong mga technology is ginatraininggid kami before kami magsampasabarko or from school pa lang, ginatunannyo ang ginatunonkaninyo. Like, for example, Excel. Excel Word, Microsoft Word, ang mgagiddayam gapabuligkaninyo. Hay kung sauladoniyo dun yung Microsoft Excel, Microsoft Word, kag mga PowerPoint, mas mahaposang trabahonyo sabarko. So, mas advantage kam ganakatuon. Doon kalansa previous nangang mga education or previous nangang ginatunan. So, ang mgamayad ngaanodukaronsa computer based ngamgabarko. (When it comes to interacting with new technologies, we undergo training before boarding the ship or even during our time in school. We are taught essential tools like Excel, Word, and PowerPoint, which greatly assist us. Knowing Microsoft Excel, Microsoft Word, and PowerPoint makes our work on the ship much easier. So, those who are familiar with these applications have an advantage.

It all boils down to the education and training received in the past. Those who are well-versed in computer-based skills have an advantage in modern ships).” It also suggests that regulatory bodies and certification requirements play a pivotal role in shaping the adaptation strategies employed by seafarers in response to technological changes.

The emphasis on compliance with regulations and updated certifications resonates with previous studies that recognize industry standards and certifications as fundamental in shaping the adaptation strategies of seafarers (Doloreux and Malançon, 2008). The focus on regulatory adherence underscores the industry's transformation, where innovation is increasingly seen as essential for efficiency, safety, and environmental protection (Blakely, 2007; Vivero, 2007).

### **Subtheme 3.5: Embracing New Technologies and Preparing for Future Trends**

Seafarers are urged to embrace new technologies and prepare for future trends in the maritime industry. Participant 2 discusses, “the impact of artificial intelligence (AI) on the seafaring profession, highlighting the need for seafarers to learn and adapt to AI advancements: Respondents 3 and 5 delve into the broader context of future trends, including potential unmanned vessels and the rise of autonomous ships. Participant 3 shared, “So, upcoming, daw may nabati-bati. Man ta nga du buslanlangka unmanned vessel future ngabarko. So, waay du kuno ibutang nga seafarers. (there's talk about the potential rise of unmanned vessels, suggesting a shift toward autonomous ships in the future. It's speculated that these vessels may not require traditional seafarers on board, and the industry is currently in the trial-and-error phase as they explore this concept.)”. The subtheme underscores the proactive approach seafarers need to take in anticipating and preparing for upcoming changes in job roles and skills driven by technological advancements. The encouragement for seafarers to embrace new technologies and prepare for future trends aligns with the concept of “Shipping 4.0” and the industry's paradigm shift towards autonomous systems (Burmeister et al., 2014). The discussion about the impact of artificial intelligence (AI) and the anticipation of trends like unmanned vessels and autonomous ships resonates with the proactive approach suggested in related studies (Burmeister et al., 2014; Stateczny, 2019).



**Theme 4: Recommendations for Navigating Technological Advancements in the Maritime Industry**

The recommendations provided by the respondents converge on the themes of continuous learning, structured time management, facility upgrades, specific equipment training, and proficiency in software applications. These recommendations collectively serve as a roadmap for seafarers, educational institutions, and industry stakeholders to navigate and leverage technological advancements effectively in the maritime sector.

**Subtheme 4.1: Continuous Learning and Training for Seafarers**

A consistent recommendation from the respondents is the emphasis on continuous learning and training for seafarers. Participant 5 underscores the, “importance of continuous learning, training, and formalization to stay updated with technological innovations.” Participant 2 also stated, “I guess the thing I want to implement is, you know, specific trainings, uh, on a specific, equipment before going on board”. The dynamic nature of the maritime industry requires seafarers, especially officers, to adapt to new lessons in technology continuously. This subtheme suggests that educational institutions and training programs should incorporate ongoing education on relevant software, such as Microsoft Excel and Word, to ensure seafarers remain familiar with the tools they use for documentation and calculations.

The dynamic nature of the maritime sector demands adaptability, especially among officers, to integrate new technologies seamlessly into their roles (Participant 5, 2024). This aligns with Pandeagua's (2019) exploration of the evolving maritime industry, highlighting a global shift towards machine-intelligent unmanned ships. It emphasizes the need for ongoing training to prepare seafarers for the impending technological transformations.

**Subtheme 4.2: Time Management Strategies for Internet Use**

The “negative impact of excessive internet use on bonding, social interaction, and productivity” is highlighted by Participant 3. To mitigate these effects, Participant 2 recommended, “implement time management strategies”. As shared by Participant 3, “So, that's why, dapatnga time nyo is Control onnyo, may time management kamo for internet, for family, for work, and for, ah, number one gidang rest time nyo. Important egidang rest nyosabarko (Therefore, it's crucial to implement time management strategies, allocating specific times for internet use, family communication, work responsibilities, and, most importantly, ensuring sufficient rest time. Balancing these aspects is essential for maintaining a healthy and productive environment on board).” Allocating specific times for internet use, family communication, work responsibilities, and rest is crucial for maintaining a healthy and productive onboard environment. This recommendation recognizes the potential pitfalls of unrestricted internet access and suggests a structured approach to balance online activities with essential shipboard duties and social interaction.

Respondents highlighted the negative impact of excessive internet use on seafarer bonding, social interaction, and productivity. To address this issue, time management strategies are recommended to allocate specific times for internet use, family communication, work responsibilities, and rest. This resonates with the broader context of technological advancements, such as autonomous shipping, where Porathe et al. (2014) underscore the need for autonomous vessels to enhance onboard working conditions and prevent seafarer shortages. Effective time management strategies become essential as technology becomes more integrated into maritime operations.

**Subtheme 4.3: Upgrading Educational Institutions and Facilities**

Acknowledging the evolving nature of technology, Participant 4 recommends that “seafarers and educational institutions need to upgrade themselves”. This subtheme emphasizes the need for continuous improvement in educational facilities, teaching methodologies, and industry practices to align with the advancements in technology. It suggests that educational institutions should play a proactive role in preparing seafarers for the latest innovations, starting from the school level and extending to professional training.

The literature by Pandeagua (2019) reinforces this notion, discussing the transformative phase in the maritime industry with the advent of autonomous ships. The call for upgrading educational institutions aligns with the need for preparing seafarers for the latest technological innovations from school-level training to professional

development.

#### **Subtheme 4.4: Specific Trainings on Equipment Before Boarding**

Participant 2 advocates for, “specific trainings on equipment before seafarers embark on their vessels”. The recommendation centers on the need for seafarers to be well-trained and equipped with knowledge about the specific technologies they will encounter onboard. This targeted training ensures that seafarers are proficient in handling the equipment relevant to their roles, minimizing challenges associated with insufficient knowledge and experience when working with advanced technologies.

This aligns with the literature's discussion on autonomous ships, where the integration of advanced technologies like RADARS, AIS, GPS, and ECDIS requires seafarers to be well-trained (Zhiixiang et al., 2016). Targeted training ensures that seafarers can effectively handle onboard equipment, minimizing challenges associated with insufficient knowledge and experience.

#### **Subtheme 4.5: Proficiency in Software Applications**

Participant 3 emphasized, “Ako, gatuon pa mnko, last time medyonabudlayanakosa Excel mo, that's why gina-emphasize gidang Excel kaninyo, para pag-abotniyosabarko, hindinakamomabudlayan (Personally, I'm still learning, and I recall having some difficulty with Excel in the past. That's why there's a strong emphasis on Excel proficiency for all of you, ensuring that when you arrive on the ship, you won't face the same challenges.” The proficiency in software applications, particularly Microsoft Excel” is emphasized. This recommendation highlights the significance of mastering commonly used software tools to enhance efficiency and effectiveness in daily tasks. The suggestion to focus on Excel proficiency aligns with the evolving demands of the maritime industry, where digital skills are increasingly essential for seafarers to perform their duties seamlessly.

The emphasis on the proficiency in software applications, particularly Microsoft Excel, as a crucial skill for seafarers aligns with the increasing digitalization in the maritime industry, where mastering commonly used software tools enhances efficiency and effectiveness in daily tasks. The broader literature by Burmeister et al. (2014) and Levander (2016) discusses the ongoing paradigm shift in shipping towards cyber-physical systems and autonomy, underscoring the importance of digital skills for seafarers.

## **DISCUSSION**

In the realm of technological advancements shaping seafarers' professional lives, respondents in the study highlight a multifaceted impact. Automation has significantly simplified various tasks, transitioning from manual procedures to automated processes such as loading, navigation, and communication. Seafarers express a positive transformation, emphasizing the efficiency and ease introduced by automation. Communication technologies have evolved, allowing global connectivity for seafarers with the integration of satellite internet, GPS, and advanced tools. However, concerns about the pressure associated with constant updates are noted. Continuous training and skill development are deemed crucial, with seafarers emphasizing the need to stay tech-savvy and proficient in computer-based skills like Excel, Word, and PowerPoint.

Maintenance and troubleshooting processes are revolutionized by advanced technology, enabling remote monitoring, digital diagnosis, and efficient problem resolution. In terms of emergency response and safety, real-time data, GPS, and advanced monitoring systems play a pivotal role, enhancing communication and safety measures. Nevertheless, concerns about GPS reliability in high-risk areas introduce a note of caution. The impact on seafarers' job satisfaction is intricate, with diverse job roles emerging alongside challenges in adaptation. Positive impacts include productivity gains, safety awareness, and career advancement opportunities. Continuous learning and adaptation are emphasized, addressing challenges while recognizing the opportunities presented by advanced technology. Seafarers employ various adaptation strategies in response to technological innovation challenges. Soft skills and a resilient mindset are considered essential, emphasizing the importance of cognitive and emotional intelligence. Continuous learning through specialized training is a key strategy to stay updated with evolving technologies, highlighting the proactive approach of seafarers in acquiring necessary skills.

Familiarity and expertise in handling technology are crucial, indicating the significance of proficiency and hands-on experience. Compliance with regulations and updated certifications is stressed, underlining the regulatory aspect of adaptation. Seafarers are urged to embrace new technologies and prepare for future trends, reflecting a proactive stance in anticipating changes driven by technological advancements.

Recommendations for navigating technological advancements in the maritime industry converge on themes of continuous learning, structured time management, facility upgrades, specific equipment training, and proficiency in software applications. Continuous learning and training for seafarers are consistently recommended, emphasizing the dynamic nature of the maritime industry. Time management strategies for internet use are suggested to balance online activities with essential shipboard duties and social interaction. Upgrading educational institutions and facilities is recommended to align with technological advancements. Specific trainings on equipment before boarding are advocated to ensure seafarers are well-prepared for the technologies they will encounter. Proficiency in software applications, particularly Microsoft Excel, is highlighted to enhance efficiency in daily tasks. These recommendations collectively serve as a roadmap for stakeholders to leverage technological advancements effectively in the maritime sector.

Further, the study sheds light on the profound and multifaceted impact of technological innovations on seafarers' professional lives in the maritime industry. The transformative effects are evident across themes such as automation, communication evolution, continuous training, enhanced maintenance, and improved emergency response. Seafarers express positive sentiments about the efficiency and ease brought about by automation, highlighting a shift from manual to automated processes. Communication technologies provide global connectivity, yet concerns about constant updates are noted. Job satisfaction is influenced by diverse roles and challenges in adaptation, alongside positive outcomes like productivity gains and career advancement opportunities. Continuous learning emerges as a key factor, underscoring the industry's dynamic nature and the need for seafarers to stay abreast of evolving technologies. Adaptation strategies encompass soft skills, continuous learning, familiarity with technology, compliance with regulations, and anticipation of future trends.

Seafarers are urged to embrace new technologies and prepare for upcoming changes, emphasizing the proactive stance required in navigating a rapidly evolving technological landscape. The study concludes with a set of recommendations, including continuous learning and training, time management strategies for internet use, upgrading educational institutions, specific equipment training, and proficiency in software applications.

Educational institutions and industry stakeholders should collaborate to provide ongoing education on relevant software tools, ensuring seafarers remain proficient in the skills required for their roles.

The shipping companies must recognize the potential challenges associated with excessive internet use and recommend the implementation of time management strategies. Allocate specific time for internet use, family communication, work responsibilities, and rest to maintain a healthy and productive onboard environment.

Encourage educational institutions and industry stakeholders to invest in upgrading facilities, teaching methodologies, and industry practices. This proactive approach ensures that educational institutions consider and configure alignment with the advancements in technology, preparing seafarers from the school level for the latest innovations and challenges.

Policy makers must advocate specific training on equipment before seafarers embark on vessels. This targeted training will ensure that seafarers are well-prepared and proficient in handling the specific technologies they will encounter onboard, minimizing challenges associated with insufficient knowledge and experience.

These recommendations collectively form a comprehensive roadmap for seafarers, educational institutions, and industry stakeholders to effectively navigate and leverage technological advancements in the maritime sector. Overall, the findings provide valuable insights into the intricate relationship between seafarers and technology, offering guidance for the industry to adapt, thrive, and ensure the safety and satisfaction of its workforce in the face of ongoing technological evolution.

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