Technostress and the Future of Work at Sea

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ABSTRACT

The maritime industry has experienced profound technological changes since the 19th century. Advancements such as big data analysis, artificial intelligence, and the Internet of Things have enhanced the functioning of ships by modernizing operation systems and making them safer, reliable and more profitable. Nevertheless, other than intensifying the efficiency of those systems, modern technologies also brought various challenges to maritime workers. For instance, research shows that the rate at which technologies are implemented in ships and the stress a seafarer is exposed to learn the functionality of new technologies has impactful adverse effects on the mental health of seafarers, this is termed as "technostress". This paper focuses on analysing the technostress phenomenon in the maritime industry. Mainly, it concentrates on determining the effects of technological stress on the mental health of seafarers on board ships. In addition, the paper seeks to investigate the status of the international legislation on technostress. Finally, since the future of the maritime industry is assumed to rely entirely on the modernization of the operations through technological advancements, this paper seeks to create awareness among the maritime stakeholders about the existence of the phenomenon of technostress and offer the necessary interventions. Results presented in this article were obtained from a field study, which is considered the first of its kind in the topic of technostress, in which the author conducted on a newly built Danish-flagged commercial vessel.

Keywords: Technostress, Seafarers, Mental health, Working conditions, Future of work at sea

INTRODUCTION

In recent years, the maritime industry has witnessed tremendous technological advancements, which have brought major changes in the type of work for maritime workers. Although such technological advancements have enhanced the maritime sector efficiency and operational safety, they have also created challenges for seafarers, especially to their mental health, since they are required to learn new skills and meet higher competence levels. The pressure on seafarers to adjust to technological advancements can result in what researchers call "technostress" (Lagdami, 2023).

Technostress refers to the psychological stress linked to the use of Information and Communication Technologies (ICT), which has emerged as a growing concern in the maritime industry (Tarafdar et al., 2007). Technostress is a phenomenon that was first introduced by Craig Brod in 1984 who described it as a modern disease of adaptation to people at work

due to being unable to cope with new computer technologies in a healthy manner (Brod, 1984).

In the context of the maritime sector, technostress characterize in multiple ways, targeting seafarers working both on the bridge and the Engine Control Rooms (ECR) of newly built vessels (Lagdami, 2023). The rapidly increasing number of advanced technologies that are being integrated into the bridge and ECR, such as Big Data Analytics, Artificial Intelligence, Virtual, and Augmented Reality, as well as the advanced and integrated bridge systems, has created a complex work environment that requires continuous adaptation, cognitive and learning skills from seafarers (Menon, 2021). Many seafarers are exposed to technostress as they navigate the way the shipping and logistics industry adapts to new information technologies ever more rapidly. The exposure is attributed to the diverse technologies seafarers use, among others, computers, tablets, and other digital devices, communication software, ship navigational systems, sensors, etc.

It is true that seafarers' well-being is not the only consideration, as the stress related to the use of technologies may impact overall ship safety, the ship operational efficiency, job performance, and the popularity and tendencies of seafarer retention (Lagdami, 2023). This is why technostress is an essential issue to be discussed and addressed in the maritime sector by shipping companies, regulatory bodies, social partners, seafarer welfare organizations, and academia.

Being a new phenomenon in the work environment, technostress became a significant matter getting increased attention by various stakeholders in all domains. This paper presents the results of the first study ever done in the maritime sector focusing on technostress. It examines the results of a field study done by the author aboard a newly built Danish-flagged ship (RoRo), during which interviews with crew members were conducted. The results of the field study were supported by research literature review focusing on technostress, including its origins and effects on workers, as well as the current international existing legal framework on the topic. The paper concludes with a discussion and recommendations on how various maritime stakeholders can help to adopt measures to avoid technostress for seafarers.

TECHNOSTRESS AND ITS DIMENSIONS

The term technostress is attributed to stress which individuals experience due to using information systems at the workplace (Hang et al., 2022). In the IT field, it is considered as the dark side of the use of technology. It has been referred to as the psychological state of stress associated with IT use (Cazan, 2020) regulated by a number of stressors (Tarafdar et al., 2014). The multidimensional nature of technostress is defined as a negative psychological state associated with the use or the "threat" to use new technologies which leads to anxiety, mental fatigue, scepticism or doubt, and the sense of efficacy (Salanova et al., 2013).

Research indicates that workers in the information and communication technology field suffer a higher degree of anxiety caused by the use of computers, including feelings such as uneasiness, discouragement, or

cognitive stress (Cazan et al., 2020). Employees working in the ICT field frequently suffer from high computer anxiety wherein they feel uncomfortable, frustrated, and stressed during the use of computers connected to the Internet which leads to multiple errors and mistakes (Cazan et al., 2020). Over the years, the concept of technostress has evolved and expanded its application across various research fields, including education, medical, and/or information systems studies. Tarafdar (2007) defined five key dimensions of technostress, leading thus to different techno-stressors. These dimensions are namely techno-complexity, techno-overload, techno-invasion, techno-uncertainty, and techno-insecurity (Tarafdar et al., 2007). Further research on the subject provides various further technostress aspects (Nisafani et al., 2020).

The technostress five stressors can be defined as follow (Tarafdar et al., 2007):

Techno-Complexity: the use of technology by workers which could be too difficult to learn or use. Workers are dealing with an overload of work due to the use of technology.

Techno-Overload: workers experience information overload and find themselves multi-tasking because of the technology, which gives them the feeling of being repulsed by the amount of information to manage as result of cognitive overload.

Techno-Invasion: workers can be disrupted by technology at anytime and anywhere.

Techno-Insecurity: workers feel insecure about their jobs when new technology is introduced or when they are unable to cope with the existing technology.

Techno-Uncertainty: workers feel unsettled by constant technological changes, modifications and upgrades.

In the maritime sector, research shows that some of these technostress stressors are mainly faced by engineers working on the bridge and ECR (Lagdami, 2023). Further studies provide evidence of techno-overload from information flooding alarm systems, which are not always related to the failures observed, techno-complexity from the varied design of technological interfaces, and techno-uncertainty from difficulties in using automated systems (Gundogdu et al., 2020). The increasing digitalization has given rise to some new concerns seafarers must deal with, such as the sense of alarm and anxiety produced by information overload. In addition to time constraints for data analysis and the accompanying pressure to solve the problem and identify the underlying reasons leads to panic and fear (Tarafdar et al., 2007).

Addressing all of these dimensions related to technostress in the maritime sector might be challenging. The maritime industry is a composite of peculiarities. Firstly, numerous regulations constrain maritime transportation. Secondly, the industry is diverse; it involves innumerable ships (Jović et al., 2022). Thirdly, the shipping organizational structure is focused or narrow; seafarers spend extended time at sea far away from their homes. Finally, the maritime sector is hierarchical and traditional, depriving a lot of seafarers of being open about their mental health. Hence, these may lead

to the process of deploying technologies rather stressful or challenging for seafarers.

ASSESSMENT OF THE INTERNATIONAL LEGAL FRAMEWORK OF TECHNOSTRESS IN THE MARITIME SECTOR

While the international legal framework for guaranteeing the well-being of workers around the globe is an issue of urgency, particularly after the crisis of the COVID-19, the maritime sector does not have many international instruments or mechanism to address the issue of stress aboard ships. Furthermore, although international and regional regulation on stress at the workplace exists, specific legal international, regional, and national or even sectoral regulations on technostress still need to be included (Lagdami, 2023). This paper outlines only the international level.

International Labour Organization (ILO) provisions

At international level, the ILO has established three key standards, including: 1) the Occupational Safety and Health Convention (No. 155) and Recommendation (No. 164): These require protecting workers' physical and mental health and implementing national OHS policies; 2) the Occupational Health Services Convention (No. 161) and Recommendation (No. 171): The standards define the role of occupational health services in maintaining safe and healthy work environments; and 3) the Promotional Framework for Occupational Safety and Health Convention (No. 187) and Recommendation (No. 197): These instruments complement other existing instruments and define national structures for implementing OHS policies (ILO, 2016).

The 2014 ILO guidelines for implementing occupational health and safety points out that being a seafarer will likely affect mental health (ILO, 2014). Seafarers are likely to suffer from various adverse impacts, such as stress, anxiety, depression, and other responses that can be immediately detrimental to their work performance and safety behaviour, as well as their quality of life. Meanwhile, conditions are primarily the result of a set of factors in the ship's workplace, among others, physical confinement within ships, relationships between colleagues, traumatic accidents, or lack of job motivation. While already stressful conditions for seafarers may be even more aggravated by the stress experienced as they worry whether anything is happening to their loved ones far away from home (Svetina et al., 2024).

However, as of September 2024, there has been no international regulation implementing the subject matter relating to seafarers' stress issues through technology coined as "technostress". Thus, considering all these factors, the Bill of Rights of Seafarers, the MLC 2016, requires more cooperation between competent authorities, representatives of seafarers, and ship owners to develop effective measures to address technostress indicators that influence the well-being of the seafaring workforce and impact the level of stress and anxiety during their working periods.

International Maritime Organization (IMO) provisions

The IMO, the regulator of international shipping, has largely unrestrained the psychosocial issues of seafarers for a long time. However, there are some dormant mandatory and voluntary regulatory frameworks to design and layout engine rooms that can be considered somehow for the protection of the psychosocial status of seafarers. For instance, Chapter II-1 of the International Convention for Safety of Life at Sea (SOLAS), specific to Construction – structure, subdivision and stability, machinery, and electrical installations: "Engine Department", which details the design and construction of the Engine Department of cargo ships, including ECR specification. Which also describes the technical layout and placement of equipment in the ECR.

Furthermore, the IMO guidelines for the design, layout and arrangement of Engine Room (IMO, 1998) are included in the non-mandatory IMO document which covers five areas of the human-machine environment of the Engine Room including familiarity; occupational health, ergonomics, minimizing risks through layout and design, and survivability (Mallam et al., 2013). Section 6.2 on occupational health stipulates the effect of the engine room environment on seafarers health. It extends to the major areas in the engine room, such as noise, ventilation, air-conditioning and temperature regulation, lighting and vibration. The implementation of the provisions of such regulations can result in reducing accidents caused by psychological and physiological stress. It also promotes workplace comfort for seafarers which can help reduce seafarers psychological and physiological risks aboard ships. These guidelines mainly focus on areas containing machinery processes; hence, the increased use of remotely controlled machinery equipment or the increased volume of big data in the engine control room need to consider extra measures in ensuring better operational work at ECR including considerations to protect the mental health of the crew in regards to the invasion of the technology.

One aspect to underscore is the latest collaboration between the IMO and the ILO to improve the occupational and mental health of crew at sea and the interference of technology in many degrees. Therefore, a joint special guidelines and training on such matters as technostress, might be needed to address the issues on-board modern ships.

IMPACT OF TECHNOSTRESS ON SEAFARERS

The investigation of technostress has been widely covered in different fields. However, to date, this paper is one of few attempts to examine the issue in the maritime industry. The aim of this paper is to investigate the perception and experience of seafarers with respect to technostress on board ships.

Methodology

This paper is the result of a research study on the topic complimented by a field study conducted on board a Danish Ro-Ro flagged vessel focusing on the bridge and the ECR. During the field study, information collected through a questionnaire and semi-structured interviews (Bryman & Bell, 2011).

The questionnaire underlined two features of technostress: the creators of technostress and the inhibitors of technostress. The two dimensions correlate well with the stress that is created while using information and communication technologies (Ragu-Nathan et al., 2008). The questionnaire pursues structural determinants of technostress defined previously by the author, including techno-overload, techno-complexity, techno-invasion, and techno-uncertainty. The inhibitors of technostress include training, developing new skills and raising awareness (Lagdami, 2023). The field study was conducted on board a ship that was performing a roundtrip voyage from Gothenburg (Sweden) - to Immingham (UK) from 19th to 22 July 2022.

Findings of the Field Study

This subsection summarizes the interviewed crew members' perception of the sources of and remedies for technostress on board ships. The dimensionality of seafarers' technostress experiences is presented based on the technostress creators, which include techno-complexity, techno-overload, techno-uncertainty, and techno-insecurity. It is complemented by giving an overview of the crew members' perception of the technostress inhibitors detected during the interviews with the crew members, which include training and new skills acquisition, IT support on board ships, Connectivity on board ships, Work identity change of seafarers, and the cultural aspect.

Technostress Creators

Techno-complexity of maritime operations pertains to the wide variety of programs on different types of vessels. Each vessel is equipped with its own set of complicated mechanisms. Therefore, seafarers often find it challenging to maintain their technological abilities when they have to move between different types of vessels based on the change in their contracts. Modern operating systems are highly complicated, making acquiring specific training and additional competencies difficult. Additionally, operators are expected to manage several systems simultaneously, causing further pressure and stress on seafarers.

Techno-overload is among the most candid challenges within maritime settings as the ship serves as a workplace and a home for crew members. As a result, seafarers experience the constant need to respond to some technology related calls, such as alarms, even during off-hours. As practice shows, such ergonomic demands are fraught with stress and fatigue because even in a highly automated and technologically advanced setting, one may feel that they never go off-duty.

Techno-uncertainty is engendered through permanent technological changes and upgrades. Unreliable connectivity and technical issues faced by crew members on different vessels contribute to this uncertainty. The need for continuous adaptation to new systems and software upgrade versions of software adds to the stress level of the crew members.

Techno-insecurity is often driven by the fear of job loss and the need for constant self-improvement in technology. The maritime sector naturally instils increased insecurity in its workers because of the contract based

character of their relations with the employer. As most seafarers, mainly ratings are employed on a short-term basis, they often do not voice their issues, including the mental health ones, on board. To mitigate the issue, training aboard the ship should be comprehensive and fitting to the task. Technostress level should be assessed for previously-issued technologies and leverages. Increasing stress levels require greater time off, standardizing systems across vessels whenever possible, enhancing Internet accommodation, and growing technology reliability. Finally, the culture of fear for crew input should be eliminated, allowing the workforce to report potential issues.

Technostress Inhibitors

Training and new skills acquisition is one of the primary issues with managing technostress among seafarers. This preventive method is usually sufficient; however, the nature of the maritime sector creates barriers. First, the skill transfer is complicated by the diversity of vessel types. In practice, competencies developed by seafarers to function technologies on a specific ship become obsolete once they are transferred to other types of vessels. This increase stress for the seafarers as well as the existing crew, who should engage in constant voluntary peer training.

IT Support on Board Ships. Unlike other work environments, seafarers have no specific IT support on board ships which is one of the critical inhibitors of technology-based stress. Seafarers on board have to resolve complex technical issues themselves. Such an approach undoubtedly raises frustration and stress among the entire crew.

Connectivity on Board Ships. An unstable internet connection or the lack of connectivity creates immense pressure and cognitive load pressure on seafarers on board ships. Various technologies that are used on board ships require a stable Internet connection, losing details, and lagging when the connection is slow. The situation is an enormous source of technostress as it is associated directly with task overload as seafarers might need to perform some tasks several times because of poor connectivity.

Work Identity Change of Seafarers. The growing impact of digitalization on the work identity of seafarers has changed from manual labour to the proficient use and maintenance of complex shipboard machinery and IT devices. This situation creates changes in the tasks that seafarers used to perform. However, it is worth noting that the nature of the work of seafarers might change but their work contract might still have the same old format with traditional tasks.

Cultural Aspect. The cultural factors found in the maritime industry are also among the principal technostress inhibitors, given that a lot of seafarers cannot open up about their stress or mental health issues by fear of job loss or difficulties to find other contracts.

DISCUSSION

This paper contributes to the understanding of the phenomenon of technostress among seafarers at sea. It provides evidence of various

technostressor's experienced by the crew onboard modern cargo ships. The paper offers an overview of the key technostressor's on board as alarm fatigue, information overload, and lack of specific training. In addition, the research demonstrates specific technostress creators on board ships, such as complexity, overload, invasion, and uncertainty. Moreover, the article presents a comprehensive view of the concept of technostress emphasizing its dependence on factors such as preparedness for the adoption of technologies, right skills, training and competencies. Through an in-depth analysis, the article offers valuable insights into the lives of seafarers who are required to adapt to a technologically overwhelming environment. This analysis requires careful considerations of its interpretation especially in the context of the maritime community's efforts to deal with the rapid technological change of the maritime industry.

CONCLUSION

This analysis reveals the unique and complex challenge of managing technostress encountered by seafarers working on board highly sophisticated ships. The findings underscore the need for tailored strategies and policies to address this issue, considering the specific context of the maritime industry. As the industry continues to evolve with innovative and technological development, it is necessary to develop comprehensive approaches that balance between the benefits of digitalisation and the well-being of seafarers. Regulations, awareness, training, and stakeholder engagement are some of the crucial points to be considered by the international maritime community to address technostress among maritime workers for a better future of work for them.

By extending technostress research into the maritime domain, an understudied context with unique technological challenges, this study provides valuable insights to inform policy makers and practitioners for supporting crew wellbeing and performance in an increasingly digital maritime industry.

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