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Women in Maritime : Aiming for a Gender-Equitable Future Workforce

By

Australian Maritime College, University of Tasmania

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Theme: 4 – Women in Maritime

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Abstract This study addresses the critical importance of gender equity within the maritime industry, particularly in seafaring professions amidst evolving digitalization and automation. Despite ongoing efforts to promote diversity, women remain significantly underrepresented in seafaring roles, necessitating a thorough examination of the factors impeding their participation and the potential for technological advancements to drive change in the current circumstances. This study aims to investigate the multifaceted factors impacting women's participation in seafaring within a highly technical shipping industry, with a secondary objective of exploring how technological development promotes gender equality and identifying required policy interventions. Employing a comprehensive methodology that integrated both quantitative data and rich qualitative insights, the study provides a robust and holistic understanding of the challenges and perceptions experienced by women seafarers. Key findings reveal that a deep-rooted male-dominated industry culture, pervasive harassment and safety risks, significant work-family conflict, and a notable absence of female role models—particularly in the leadership positions, and the lack of robust mentorship programs are primary impediments to women's participation. It has been found that digitalization and automation are widely perceived as "Very helpful" or "Moderately helpful" in promoting gender equality by mitigating traditional physical demands, enhancing connectivity, improving safety, facilitating accessible training, and creating new professional avenues. The significance of this study lies in its timely empirical investigation, providing a comprehensive understanding of women's integration into the maritime sector. It uniquely illuminates the transformative role of technology in overcoming barriers and proposes actionable policy recommendations for diverse stakeholders, including shipping companies, international maritime organizations (like the IMO), governments, and educational institutions. These interventions, which leverage technology, span cultural transformation, combating harassment, mitigating work-family conflict, enhancing mentorship, and ensuring equal opportunities, offering a pragmatic roadmap for a more inclusive, sustainable, and resilient maritime future. Looking forward, the most promising avenues for future research include conducting a rigorous longitudinal study to assess the long-term effectiveness of policy interventions, undertaking cross-cultural comparative studies to explore contextual differences in factors and policy efficacy, and delving deeper into the precise impact of specific technological interventions on reducing gender-specific barriers. These future research directions are vital for further advancing the critical agenda of gender equity within the maritime industry.

Keyword: *Gender Equality, Maritime Industry, Women Seafarers, Digitalization, Workforce Diversity, Human Factor, Human Element, shipping, Seafaring*

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Executive Summary

The global maritime industry, particularly the seafaring profession, has historically been characterized by a profound gender imbalance, with women constituting a mere 1.2% of the global seafaring workforce despite sustained international efforts to promote diversity. This severe underrepresentation is rooted in deeply entrenched structural, cultural, and institutional barriers. This research project presents a timely and in-depth investigation into the complex interplay of factors influencing women's participation in the seafaring profession, particularly within the context of a rapidly digitalizing maritime industry. Drawing upon a comprehensive literature review that traces the historical trajectory of women's workforce participation and identifies key drivers and persistent challenges across diverse industries, this research also aims to explicitly explore how technological advancements foster gender equality and propose actionable policy interventions for a more equitable future.

Employing a robust mixed-methods research design, this study integrated both quantitative and qualitative data to comprehensively understand the dynamics of women's participation. A total of 108 participants, comprising active seafarers, shore-based maritime professionals, and other industry stakeholders from the international maritime community, were engaged. The quantitative survey contained 25 multiple-choice questions. The qualitative data were collected by asking participants open-ended questions for deeper insights. This approach facilitated the capture of both the measurable prevalence of specific barriers and the nuanced perceptions and lived experiences of women. Quantitative data underwent descriptive statistical analysis, while qualitative insights were analyzed using thematic analysis, with triangulation employed to enhance the reliability and richness of the findings. The insights gleaned from this meticulous methodology form the bedrock for a detailed analysis of key findings and the formulation of strategic recommendations.

Key Findings: The analysis revealed several critical and interconnected factors influencing women's participation in seafaring. Foremost among the barriers identified is a deeply entrenched male-dominated industry culture. This pervasive cultural norm manifests in various gender-specific challenges, leading to an environment where current equality initiatives are often perceived as only "moderately effective." Qualitative data frequently highlighted the need for fundamental shifts in industry mindsets, emphasizing that "respect and skill matter more than gender" in fostering true equality. Complementing this, pervasive harassment and significant personal safety risks emerge as a major impediment, with approximately 40% of respondents reporting direct experience or witnessing such incidents. The inconsistent handling of these critical issues further exacerbates an already challenging environment for women seafarers.

A significant challenge also stems from work-family conflict, identified as the third most impactful barrier. Family responsibilities are perceived to considerably impede women's career progression, with a large proportion of respondents finding it "Moderately" to "Very difficult" to balance their professional and personal lives. This difficulty is often exacerbated by a lack of comprehensive family-friendly policies within the industry, such as flexible contracts, predictable schedules, and adequate parental leave provisions. Furthermore, the absence of visible female role models, particularly in leadership positions, combined with a striking lack of robust mentorship programs, significantly curtails the aspirations and guidance available to prospective and current women seafarers. While organizational support for gender diversity is recognized to exist to a "large extent," a critical gap persists in the provision of structured career guidance and mentorship. Lastly, while less frequently cited as a primary barrier by all respondents, wage disparities were noted by a segment of the participants, suggesting that economic inequality can also act as a deterrent to women's entry and retention in the sector.

Conversely, the study unequivocally highlights the transformative potential of digitalization and automation as powerful enablers for promoting gender equality in maritime careers. A vast majority of respondents expressed optimism regarding technology's role, with 55% deeming it "very helpful" and 27% "moderately helpful." Qualitatively, participants articulated that technology "levels the playing field" by reducing the reliance on traditional physical strength through automation, digital tools, and smarter vessel operations. This significantly broadens the scope of roles accessible to women. Furthermore, digitalization markedly enhances connectivity, enabling seafarers to maintain more frequent and meaningful communication with family, which is perceived as a critical factor in mitigating work-family conflict. Technology is also viewed as instrumental in improving onboard safety and security through advanced monitoring systems, facilitating accessible virtual training and

education platforms, and creating new shore-based professional opportunities that may be more appealing or logistically feasible for women. These findings suggest that embracing technological advancements is not merely an operational imperative but a strategic pathway toward redefining maritime roles and making the industry more attractive and inclusive for women.

Conclusion and Recommendations: The comprehensive analysis firmly establishes that achieving a gender-equitable future workforce in the maritime industry necessitates a strategic integration of targeted policy interventions with the transformative capabilities of digitalization. The study concludes that the identified barriers—a male-dominated culture, the persistent threat of harassment, work-family conflict, and the absence of role models and mentorship—must be directly addressed through actionable policies. The framework developed from this research underscores that technology is a crucial enabler, supporting interventions across five key pillars:

1. Addressing Male-Dominated Industry Culture: This requires systemic reforms including mandatory, annual gender sensitivity and unconscious bias training, coupled with the integration of Diversity & Inclusion (D&I) Key Performance Indicators (KPIs) into management performance reviews, monitored through HR analytics dashboards. Inclusive language guidelines, supported by AI language checkers, are also essential.
2. Combating Harassment and Ensuring Safety: Implementation of robust zero-tolerance policies with clear sanctions, alongside confidential digital reporting channels (e.g., secure mobile apps), mandatory impartial investigations, comprehensive victim support programs and tele-counseling, and secure digital communication tools, is paramount.
3. Mitigating Work-Family Conflict: This necessitates the adoption of flexible contracts and predictable schedules facilitated by advanced crew scheduling software, comprehensive family leave policies, and enhanced remote work options supported by reliable onboard internet and cloud collaboration tools.
4. Enhancing Role Models and Mentorship: Strategic policies to establish formal, company-wide mentorship and sponsorship programs for women, utilizing online mentorship platforms and virtual reality (VR) simulations for leadership training, are critical. Promoting women's achievements through social media campaigns and digital storytelling can further boost visibility.
5. Ensuring Equal Opportunities: This involves implementing gender-neutral recruitment and promotion processes, potentially via anonymized applicant tracking systems, establishing transparent wage structures with regular audits, ensuring equitable access to training through online learning platforms, and designing inclusive shipboard facilities.

The significance of this research extends to its timely empirical investigation, providing a robust understanding of women's integration into the evolving maritime sector. It uniquely illuminates technology's pivotal role in overcoming entrenched barriers and offers a pragmatic roadmap of actionable policy recommendations for a diverse array of stakeholders, including shipping companies, international maritime organizations (like the IMO), national governments, and educational institutions. These interventions are designed to align with global gender equality agendas and foster a more inclusive, sustainable, and resilient maritime future. Looking ahead, promising avenues for future research include conducting rigorous longitudinal studies to assess the long-term effectiveness of implemented policies, undertaking cross-cultural comparative studies to understand regional differences, and delving deeper into the precise impact of specific technological interventions on reducing gender-specific barriers. These future inquiries are vital for continually advancing gender equity within the maritime industry.

1. Introduction

1.1 Background of the Study

The maritime industry has long been characterized by its traditionally male-dominated workforce, particularly in the seafaring profession (Ishida, 2022). Despite international advocacy and policy reforms to enhance gender diversity, women's participation in maritime roles, especially as seafarers, remains significantly limited. According to recent reports, women represent only about 1.2% of the global seafaring workforce (Ashok Srinivasan, 2021; Narayanan, Emad and Fei, 2023). The persistent underrepresentation of women in this field highlights deeply embedded structural, cultural, and institutional barriers.

While historical trends have shown that women were largely excluded from seafaring profession due to prevailing gender norms and perceptions of physical inadequacy, the 21st century has witnessed gradual, albeit slow, progress (Ferati et al., 2023; Narayanan, Emad and Fei, 2023). Efforts by organizations such as the International Maritime Organization (IMO), the International Labour Organization (ILO), and several national maritime administrations have aimed at addressing gender inequality in this field. However, the progress is not uniform across regions and ranks within the industry, and significant gender disparities persist in recruitment, training, retention and career advancement.

Parallelly, the maritime industry is undergoing transformative changes due to technological advancement, including automation, digitalization and smart shipping. These shifts offer new opportunities to reconfigure the seafaring workforce by making certain aspects of the job less physically demanding and more skill-focused, potentially reducing some of the traditional barriers for women (Watson, Corliss and Le, 2018; Prabha et al., 2023). However, the intersection of gender and technology in maritime remains under researched, especially in the context of how digital innovations can be leveraged to support gender equity.

1.2 Research Problem

Despite global recognition of gender disparities in the maritime sector and growing efforts toward equality, the inclusion of women in seafaring roles remains limited and largely symbolic in many contexts. Previous studies (Kitada, 2021; Mahdawi and Evans, 2022) have identified numerous barriers, ranging from workplace harassment and lack of safety measures to discriminatory hiring practices and rigid cultural norms that deter women from pursuing and sustaining careers at sea. These issues are compounded by regional disparities, employment structures such as flags of convenience, and systemic inequalities in education and training.

Moreover, while emerging technologies are reshaping the maritime profession (Narayanan, Emad and Fei, 2023; Prabha et al., 2023), there is insufficient empirical studies exploring whether and how these technologies can mitigate the gender-specific challenges faced by female seafarers. Some studies (Narayanan, Emad and Fei, 2023; Olajide, 2024) suggest that digitalization and automation may create a more inclusive environment by reducing physical demands and increasing shore-based remote operations. Nevertheless, these possibilities remain speculative without focused research that addresses the lived experiences, expectations and professional trajectories of women in a technologically evolving seafaring environment.

Thus, there is a critical need for a comprehensive investigation into how technological transformation in the maritime industry may affect women's participation. Without such research, policy recommendations and industry interventions risk being inadequate or misaligned with actual gendered experiences and barriers.

1.3 Research objectives

This study aims to conduct extensive investigation into the factors impacting women's participation in seafaring in a highly digitalized future shipping industry. Our previous research gave indications of technology easing off some barriers that deter women from taking up maritime profession (Narayanan et al., 2023). However, it was clear that more research is needed to identify what factors will further improve the recruitment, training, mentoring, and retention of women in this historically male-dominated career.

This research is well aligned with the IAMU Tasmanian Statement Objective 2: Linking the research to the work of IMO's Gender Programme – 'Women in Maritime' and Objective 5: Finding a common position and voice – 'Need for more female seafarers'. Improving gender equality and women empowerment in maritime sector will also be a step towards achieving the United Nations' Sustainable Development Goal 5 'Achieve gender equality and empower all women and girls. With the above aim in focus, the following research questions were framed to elicit data from the study respondents:

a) How are the ongoing digitalization and automation onboard ships impacting women's participation in the maritime sector?
b) What needs to be done to ensure gender parity in a highly digitalized future shipping industry?
c) Are there any concurrent factors such as nationality, educational background or age that may influence women's participation in the maritime sector?

1.4 Significance of the Study

This study is timely and necessary for several reasons. First, it contributes to a growing but still limited body of knowledge that explores gender dynamics within the maritime industry, especially in the context of technological advancement. By focusing on the potential of digitalization and automation to ease gender-specific barriers, this study introduces a forward-looking perspective that aligns with ongoing industry changes.

Second, the study aligns directly with global policy agendas. It supports the International Maritime Organization's (IMO) Gender Programme and addresses two key objectives of the IAMU Tasmanian Statement: Objective 2, which links research to the IMO's gender agenda, and Objective 5, which emphasizes the importance of increasing the number of female seafarers. Furthermore, this research contributes to the United Nations Sustainable Development Goal 5, which aims to achieve gender equality and empower all women and girls. In doing so, the study also reinforces broader efforts to ensure a more equitable and sustainable future workforce in the maritime sector.

Lastly, the study is significant for stakeholders including maritime education and training institutions, shipping companies, policymakers, and international regulatory bodies. Its findings can inform the development of inclusive recruitment strategies, targeted training programs and gender-sensitive workplace policies. By offering evidence-based insights into the relationship between technology and gender inclusion, the study serves as a foundation for crafting interventions that are not only progressive but also pragmatic and grounded in the realities of the seafaring profession.

2. Literature Review

2.1 Introduction

The trajectory of women's participation in the workforce has been a subject of ongoing evolution and transformation throughout history. This review undertakes a comprehensive exploration of this dynamic, tracing the historical progression of women's participation in workplace. It delves into the multifaceted drivers that have propelled women's participation and continued their presence in the workplace, analyzing the intricate interplay of socio-economic factors, cultural shifts and technological advancements. The review also provides the current status of women participation in other industries with a particular focus on the Blue Economy industries. However, among the Blue Economy industries, the main focus of this review is on the women's participation in seafaring profession, especially in the merchant fleet at officer ranks. As a result, the review explores the barriers of women's participation in seafaring profession and the impact of digitalization and automation on their participation in this profession.

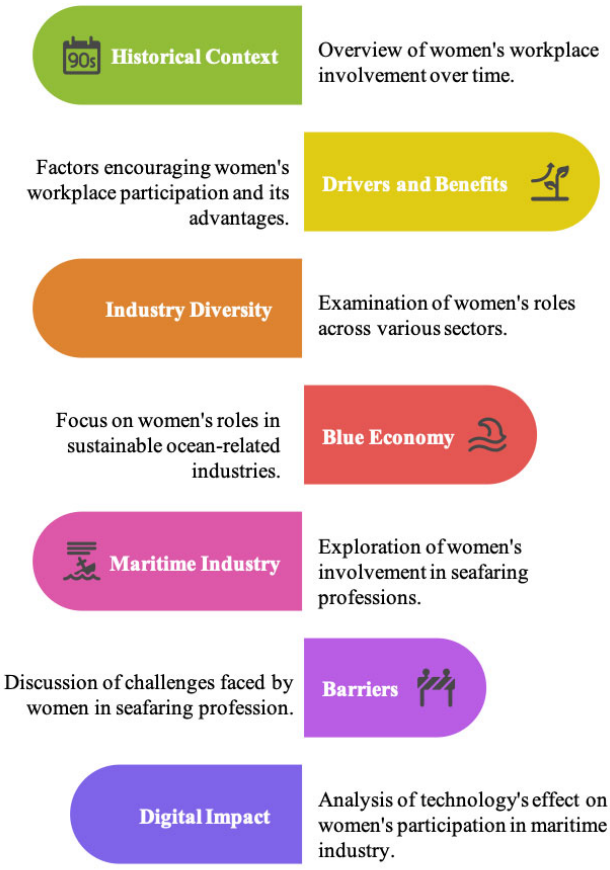


Figure 1: Conceptual Framework of Literature Review

2.2 Historical Context and Evolution

Women's participation in economic activities can be traced back to ancient civilizations. In early agricultural societies, women played crucial roles in farming, trading, and domestic production (Estlund, 1995; Milkman, 2013). During the medieval period (feudal society), women's participation in the workforce was closely linked to family trades and guilds (Horrell and Humphries, 1995; Prasad and Eylon, 2001). Many women worked alongside

their husbands in crafts such as weaving, blacksmithing, and midwifery. The feudal system, however, largely restricted women to agricultural labor and household chores. Aristocrats and noblewomen occasionally played administrative roles in state matters, while some women in urban areas were able to engage in commerce and financial activities.

The industrial revolution marked a significant turning point in women's participation in workplace. As mechanized production system expanded, many women moved from rural agricultural work to factory jobs (Horrell and Humphries, 1995). Industries such as textiles and garment manufacturing heavily relied on female labor, leading to a significant shift in gender roles. This scenario is still prevalent in many developing countries. However, working conditions were harsh, with long hours, low wages, and poor workplace safety. The 19th and early 20th centuries saw increasing advocacy for labor rights, including better working conditions for women which ultimately paved the way for labor laws and gender-specific protections (Horrell and Humphries, 1995).

The two world wars further accelerated women's integration into the workforce. As men were conscripted in military service, women took the roles in manufacturing, engineering, and administrative services, demonstrating their capability in various industries (Falconi *et al.*, 2020). Post-war periods, however, saw a push for women to return to domestic roles, though the momentum for female workforce participation had already been established. The latter half of the 20th century saw feminist movements advocating for equal rights, leading to legislative changes such as the equal pay act and the anti-discrimination law (Prasad and Eylon, 2001; Falconi *et al.*, 2020).

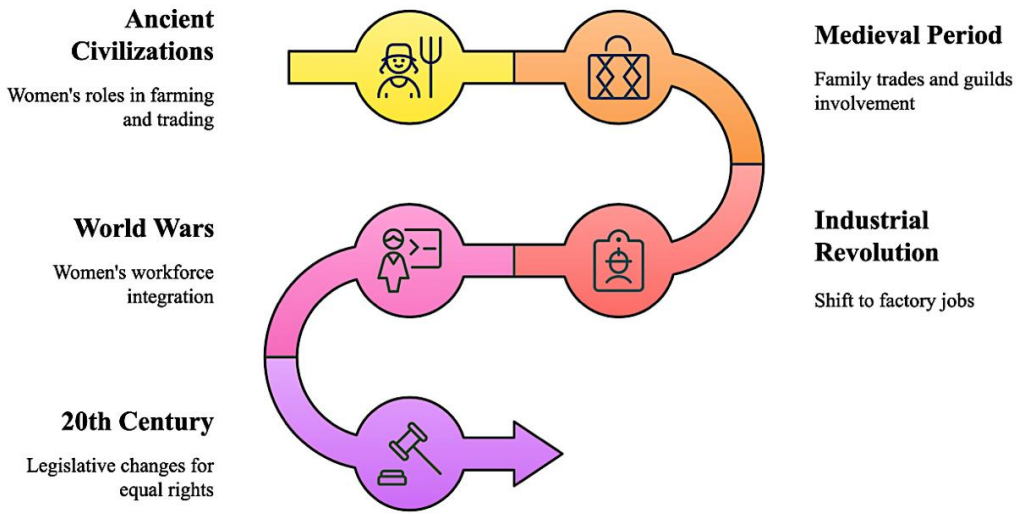


Figure 2: Evolution of women participation in workforce
(Sources: Prepared by authors based on data from previous studies)

Today, women's participation in various workforces continues to evolve with the rise of digital economies, automation, and changing societal norms. Women have entered various fields previously dominated by men, including technology, finance, and space exploration. However, challenges such as wage gaps and underrepresentation in leadership roles yet persist in most of the industries across the globe.

2.3 Drivers, Benefits and Complexity of Women's Participation in Workforce

Several factors have contributed to the increasing participation of women in the workforce and a number of studies have been conducted to explore the factors for diverse industries and regions. However, there are some common

factors accelerating women participation in workforce irrespective to nature of industries and cultural norms. Education has been one of the primary enablers (Horne, Kühn and Yoon, 2017; Kelly *et al.*, 2021). Improved access to schooling and higher education has opened career opportunities for women. While increased access to education is generally associated with higher employment rates for women, several studies (Steiber, Berghammer and Haas, 2016; Chatterjee, Desai and Vanneman, 2018; Singh and Sethi, 2024) indicate that this is not universally true. The strength of correlation between education and women employment varies significantly between countries and across the family life cycle (Steiber, Berghammer and Haas, 2016). The relationship between education and women employment can exhibit a U-shaped pattern where both illiterate and highly educated women show higher participation rates, suggesting that education alone may not be sufficient to drive workforce engagement (Singh and Sethi, 2024). The socio-economic context, including rural-urban disparities and cultural norms, significantly influences women's workforce participation. For instance, educated women in urban areas tend to have higher participation rates compared to their rural counterparts (Paul & Goswami, 2022). As a result, policymakers must understand that while education is a critical factor in enhancing women's workforce participation, it is not the sole determinant. Cultural attitudes, economic conditions, and policy frameworks also play vital roles in shaping women's employment outcomes, indicating that a multifaceted approach is necessary to address these challenges effectively.

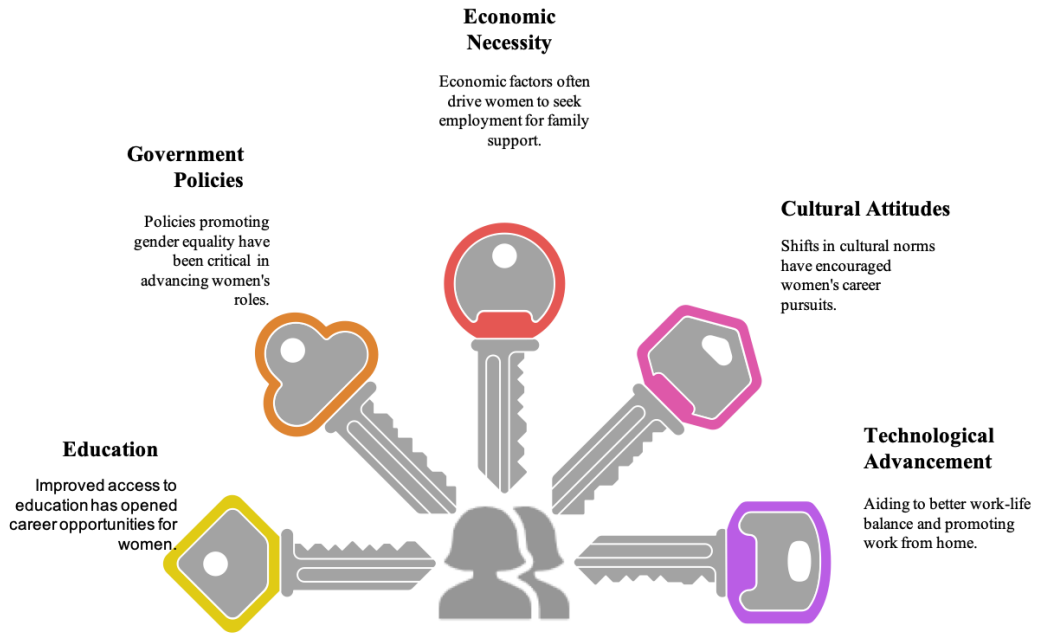


Figure 3: Major Drivers of Women's Workforce Participation

(Sources: Prepared by authors based on data from previous studies)

Government policies promoting gender equality, such as paid parental leave, affordable childcare support and anti-discrimination laws create an enabling environment for women to enter and remain in the workforce. Wage equality measures and affirmative action programs can help close gender pay gaps and increase women's representation in leadership roles (Kelly *et al.*, 2021; Lari *et al.*, 2022). Besides, economic necessity has historically been a major driver of female workforce participation (Christiansen *et al.*, 2016; Kelly *et al.*, 2021; Lari *et al.*, 2022). Economic downturns and inflation often push women to seek employment to support family

incomes. Additionally, shifts in cultural attitudes and the increasing acceptance of dual-income households have encouraged more women to pursue careers in different industries (Christiansen *et al.*, 2016; Kelly *et al.*, 2021).

Women's participation in the workforce yields significant economic and social benefits. On an economic level, gender-inclusive workplaces contribute to GDP growth, innovation, and enhanced business performance. Studies (Christiansen *et al.*, 2016; Horne, Kühn and Yoon, 2017; Kelly *et al.*, 2021; Lari *et al.*, 2022) show that women's contributions in various industries have driven economic growth and enhanced labor market efficiency. From a social perspective, increased female employment has led to shifts in traditional gender roles, promoting greater independence and self-sufficiency among women. Women's financial independence has also been linked to improved social outcomes, including higher levels of education for children and better health and nutrition standards within families. Additionally, gender-diverse workplaces foster greater creativity, inclusivity, and broader representation of consumer needs.

On the other hand, women's participation also initiates several complexities, particularly regarding work-life balance (Izzaty Shahirah Nor Sham, Salleh and Syahirah Syed Sheikh, 2021; Promita Mukherjee and Madhvi Agarwal, 2023). Many women continue to bear the primary responsibility for household and caregiving duties, leading to increased stress and challenges in career advancement. The increased employment of women has significantly altered family dynamics. Dual-income households have become more common, leading to shifts in caregiving responsibilities and family roles. While this has enabled greater financial stability, it has also introduced challenges such as childcare accessibility and work-life balance struggles. Besides, workplace biases, discrimination, and gendered expectations further complicate career progression for women (Semyonov, 1980; Hossain and Shirazi, 2018; Ayaz *et al.*, 2021), necessitating structural reforms to create equitable opportunities. Greater representation of women in leadership and decision-making roles has led to policy shifts that address issues such as workplace harassment, parental leave, and equal pay.

Technological advancements and globalization have also expanded job opportunities for women (Watson, Corliss and Le, 2018). The rise of remote work, the gig economy[1], and flexible work arrangements have enabled women to balance careers with caregiving responsibilities. Technological advancements have not only created new job opportunities for women in emerging sectors but have also facilitated greater flexibility in work arrangements, enabling women to better balance work and family responsibilities (Prabha *et al.*, 2023). Furthermore, corporate diversity initiatives have sought to promote workplace inclusivity, leading to a more gender-balanced workforce in many sectors.

2.3 Women's Participation in Diverse Industries

The presence of women in diverse industries has witnessed a significant upswing in recent decades, although disparities persist across sectors and levels of seniority. The historical trajectory of women's participation in diverse industries reveals a complex interplay of progress and setbacks. In the early 20th century, women's involvement in manufacturing and industrial jobs increased during war-time but often declined after the wars (Falconi *et al.*, 2020) as mentioned earlier. The mid-20th century witnessed a gradual expansion of women's participation in professional fields, driven by the women's rights movement and changing social norms (Prasad and Eylon, 2001; Falconi *et al.*, 2020). Beyond the significant progresses women have made in diverse

[1] a labour market characterized by the prevalence of short-term contracts or freelance work as opposed to permanent jobs

professional fields, their presence and contributions across a wide spectrum of industries, including the burgeoning "blue economy," warrant detailed examination as the progress was not uniform across industries and occupational segregation persisted. This section delves into the current status of women's participation in diverse industries, highlighting both their achievements and the pressing challenges they face.

In traditionally male-dominated fields like finance, technology and engineering, women's representation has grown, yet they remain underrepresented at the top executive and board-member levels (Ferati *et al.*, 2023). According to UNESCO's education report in 2021, women constitute approximately 28% of the STEM (Science, Technology, Engineering, and Mathematics) workforce globally. While some countries, such as Norway, Canada and Sweden, have made significant strides toward gender equality in STEM careers, others continue to struggle with cultural biases that deter women from pursuing science and engineering fields. WEF showed in their report in 2019 that women constitute only 28% of scientific researchers. There are only five countries who have achieved gender parity with women making 45-50 percent of researcher. The technology sector, while increasing the numbers of women in entry-level positions, struggles with retention and advancement, often attributed to workplace culture and biases. Similarly, in the seafaring, manufacturing and construction industries, women are gradually making inroads but their numbers remain relatively low, mostly due to occupational segregation and perceptions of these fields as "men's work." Women's participation remains relatively low in these industries due to the nature of the jobs (separation of women from families for long time), physical demands, workplace culture, and lack of family-friendly policies.

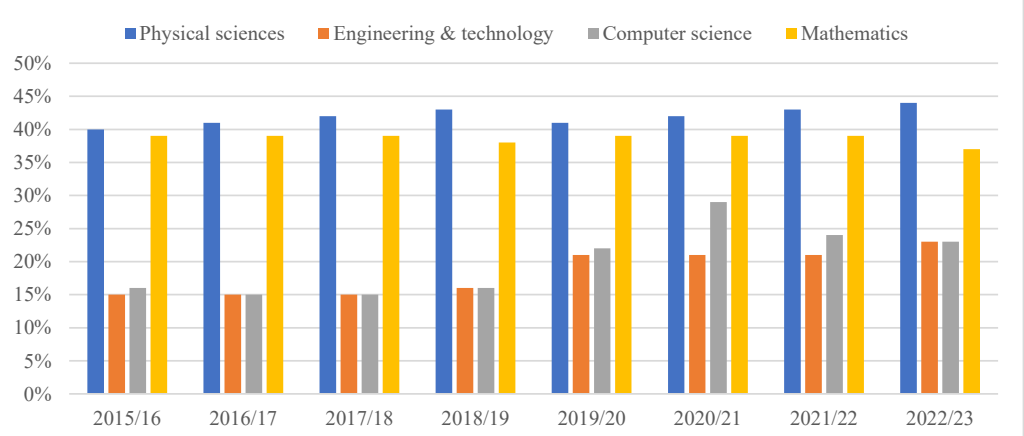


Figure 4: Women participation in STEM

(Source: Authors based on data of WEF and STEM Women)

In contrast, sectors like healthcare, education, and social services have historically seen a strong female presence and women continue to dominate these fields (Ayaz *et al.*, 2021; Walton, 2022). Women make up approximately 70% of the global healthcare workforce, serving as nurses, doctors, and researchers (Ayaz *et al.*, 2021). Similarly, in education, women dominate teaching positions at primary and secondary levels (Evetts, 2017; Kelleher, 2021). However, even within these sectors, gender pay gaps and limited access to leadership positions persist. Moreover, women participation at university teaching positions and in senior administrative roles such as

university chancellors and policymakers is underrepresented (Prashanth and V., 2021; Ferati *et al.*, 2023). The service industry, encompassing retail, hospitality, and tourism, employs a large proportion of women, but these jobs are often characterized by low wages, precarious working conditions and limited opportunities for career development.

Several factors contribute to the increasing or decreasing trends in women's participation across these industries. The increase in women's representation in professional fields like law, medicine and business can be attributed to higher education attainment among women, changing societal expectations and greater awareness of gender equality (Christiansen *et al.*, 2016; Kelly *et al.*, 2021). The growth of the service sector, particularly healthcare and education, has also provided more employment opportunities for women. However, in some traditional industries, physical demands and workplace culture may pose challenges for women. Occupational segregation, where women are often channeled into specific roles, limits their access to other opportunities (Estlund, 1995; Milkman, 2013; de Noronha, Lucena and Souza, 2024). Lack of family-friendly policies, such as affordable childcare and parental leave, can also hinder women's participation, particularly in demanding industries.

The **Global Gender Gap Report in 2024** shows that while progress is being made toward gender equality, it is happening very slowly. The report measures gender equality across four areas- economic participation (jobs and wages), education, health, and political leadership. Currently, the world has closed 68.5% of the gender gap which means that women have access to around 68.5% of the opportunities and resources that men do, leaving a 31.5% gap that still needs to be addressed. If we compare the gender gap score of 101 countries which have been covered continuously since 2006, the gap has only improved +0.1 percent point. At this pace, full gender parity (100%, where men and women both have equal access to the opportunities and resources) will be achieved after 134 years which is far beyond the target of 2030 Sustainable Development Goals (SDGs). These statistics highlight the necessity of immediate policy actions to achieve the SDG-5.

Among the 146 countries analyzed in 2024 report, 97% countries have closed at least 60% of their gender gap which indicates an improvement from 85% countries in 2006. This means that although most countries have made some progress, only a few are close to full equality. Iceland is the most gender-equal country, having closed 93.5% of its gender gap that means women in Iceland have nearly the same opportunities as men in jobs, education, healthcare, and politics. Other countries that are leading in gender equality include Finland, Norway, and New Zealand. When we look at different regions, Europe is the most gender-equal, having closed 75% of its

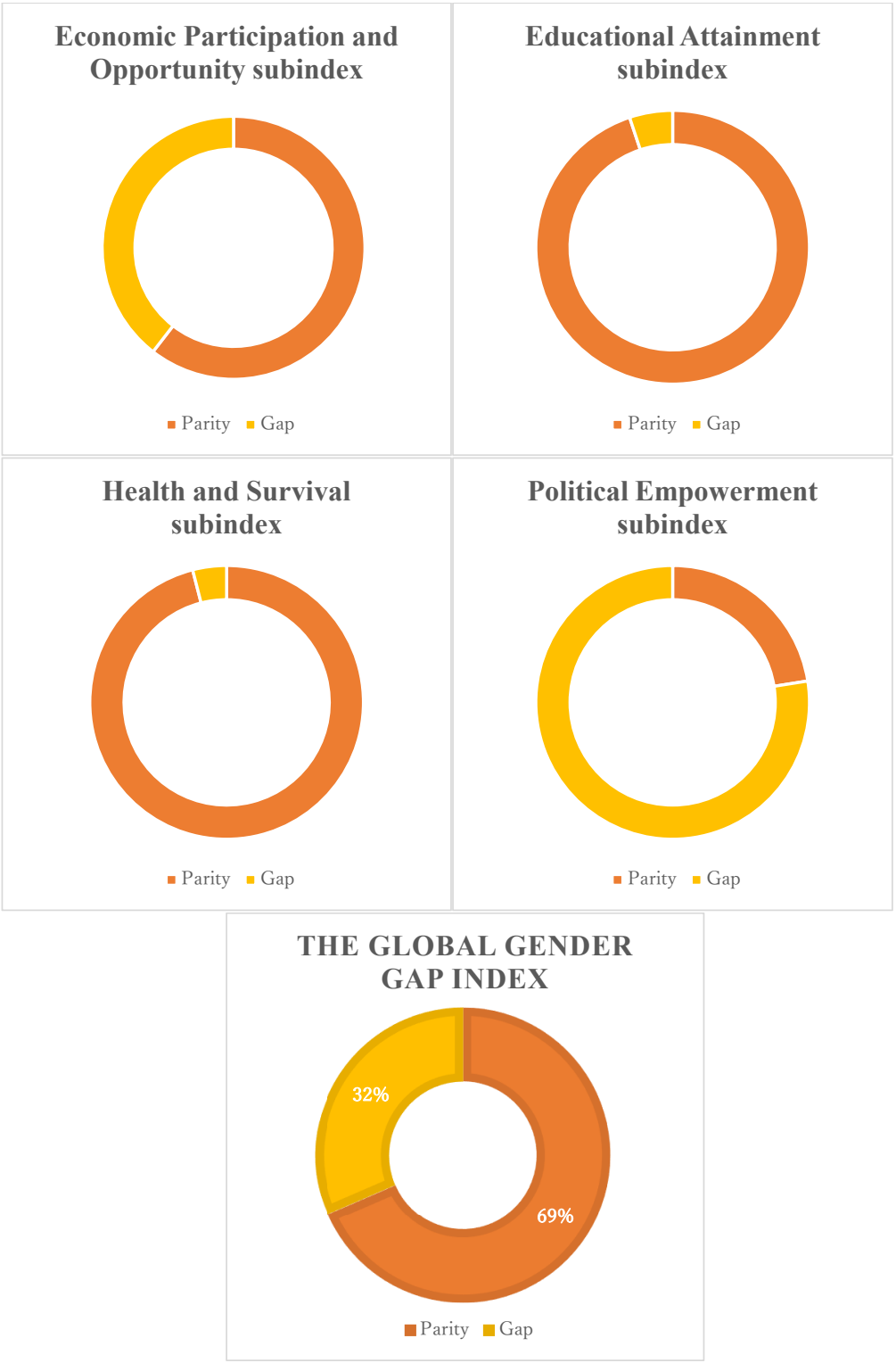


Figure 5: The Present status of gender gaps, by sub-index
(Source: Authors based on data of WEF GGGR 2024)

gender gap, followed by North America (74.8%) and Latin America (74.2%). On the other hand, the Middle East and North Africa have the least progress score, with only 61.7% of their gender gap closed. This means that women in those regions still face significant barriers to employment, education and political participation.

Among the four areas measured in this report, economic and political participation of women remains the least progressive areas. Only 60.5% of the economic gender gap has been closed by majority of the countries, meaning that women still earn less and have fewer career opportunities than men in majority of the countries. At the current rate, it would take 152 years for women to have the same job opportunities and earnings as men worldwide. Besides, women's participation in the workforce remains unequal. Although women are overrepresented in fields like healthcare (62.1%), education (54.4%), and government jobs (50.7%), only 42% of the global workforce is female. In addition, they remain underrepresented in industries like oil, gas, and mining (24.1%), transportation (31.6%), and infrastructure (22.4%). Similar situation is found in political participation of women. Only 22.5% of the political gender gap has been closed, meaning that women are still vastly underrepresented in government leadership roles. If things don't speed up, it will take 169 years before women have equal political representation as men. Although more women are becoming members of parliament and ministers, the number of female heads of state (like presidents or prime ministers) has decreased.

The **World of Work Outlook for Women in 2024** highlights the persistent gender disparities in the workforce. Despite increasing female participation, women are still facing barriers in career progression, flexibility, and leadership roles. The report shows that in 2023, for every 100 men promoted to managerial positions, only 87 women received similar promotions. This figure indicates the challenge of career advancement for women. The survey in 2024 found that approximately 60% of women are considering leaving their current jobs due to insufficient workplace flexibility, suggesting that companies need to rethink work structures to retain female talent. However, efforts toward gender equality in the workplace remain sluggish. While 52% of companies report that their pay equity initiatives are on schedule, the remaining 48% are either behind or have no initiatives at all. Diversity, Equity, Inclusion, and Belonging (DEIB) programs have been established in many organizations, but one-third of employees report little or no progress.

Technology plays a mixed role in gender equality. While 68% of employers in the Asia-Pacific region are optimistic about the positive impact of technology on gender diversity, the figure is lower in other regions, such as Europe, Middle East, and Africa (**only 57%**). This indicates regional disparities in perceptions of technological impact on gender equality. Advances in AI-driven hiring and flexible work arrangements are helping companies recruit more diverse talent, but workplace technology adoption remains uneven across industries. Industry-specific data reveals that 57% of professionals in healthcare and life sciences believe technology fosters gender equality, while this figure rises to 67% in the IT and energy sectors, highlighting the varying impacts of technology across different fields. Furthermore, a majority of small and micro-sized businesses, at 57% and 56% respectively, acknowledge that advancing technology contributes positively to gender equality, although larger enterprises report slightly higher figures at 62%. The flexibility afforded by new technology is also noteworthy, with 65% of respondents indicating that it has enabled greater workplace adaptability, thereby facilitating the inclusion of diverse talent. Overall, the evidence suggests that technology not only aids in recruitment processes but also plays a crucial role in creating a more equitable work environment.

The report also highlights that women are becoming more ambitious. In 2023, 80% of women expressed a desire for promotion, compared to 70% in 2019. However, their ambitions do not always translate into leadership roles; only 5.8% of Fortune 500 CEOs are women. In top management roles, only 42% of companies are on track

with gender equity initiatives. Looking ahead, employers need to accelerate efforts in leadership development, internal mentoring, and flexible work policies to close persistent gaps. Failing to act on gender diversity could have economic consequences as studies indicate that greater female workforce participation could add $5.87 trillion to the global economy in the next decade. Besides, companies that fail to invest in gender diversity risk falling behind as studies also show that businesses with greater gender-diverse boards outperform those with less diversity.

The Gender at Work report by the World Bank in 2014 highlighted the persistent economic exclusion of women across various sectors, emphasizing that progress toward gender equality in the workforce remains slow and uneven. Despite decades of policy interventions, global female labor force participation remains stagnant at around 45%-50%[2], with some regions, such as the Middle East and North Africa, reporting as low as 21%. Women are significantly underrepresented in stable and full-time employment. In South Asia, for instance, men are more than three times as likely as women to hold such positions. Economic disparities extend beyond employment status as women earn 10–30% less than men in paid work. This wage gap persists even in high-income economies. The report attributes much of this disparity to occupational segmentation as women are often concentrated in lower-paying sectors with limited career growth. Only 21% of senior management roles globally are held by women, highlighting the challenges in career advancement. Entrepreneurship also presents gender-based barriers. In Latin America and the Caribbean, half of women-owned businesses operate without employees, compared to 38% of businesses owned by men, reflecting systemic limitations in accessing resources and financial support. Similarly, in Ethiopia, female-headed farms produce 35% less output per hectare than male-headed farms due to restricted access to agricultural inputs.

The report further explores the intersection of social norms and gender inequality, revealing that nearly 40% of people globally and almost 50% in developing countries agree that men should have greater access to jobs when employment is scarce. This bias extends to workplace dynamics where women frequently face discriminatory hiring and promotion practices. Additionally, over 35% of women worldwide have experienced gender-based violence, further limiting their economic independence and professional opportunities. Moreover, legal discrimination remains a significant obstacle in 128 out of 143 countries maintaining at least one form of legal gender differentiation. In 15 countries, women still require their husband's consent to work. Such legal and institutional barriers disproportionately affect women's ability to own property, access credit, and secure stable employment, particularly in regions with entrenched patriarchal norms.

To address these challenges, the report advocates for gender-smart job strategies, including the elimination of legal restrictions on women's work, increased private-sector engagement in gender equality initiatives, and enhanced access to entrepreneurship resources. By implementing inclusive labor policies and ensuring equitable access to education and capital, economies can harness the untapped potential of women in the workforce, fostering long-term economic growth and social development. In the Blue Economy, increasing awareness of gender equality and the potential for women's economic empowerment has led to some progress in certain sectors. However, deeply ingrained cultural norms, limited access to resources and training, and safety concerns continue to pose barriers to women's full participation.

2.5 Women's Participation in the Blue Economy

[2] Meaning that out of 100 women only 50 women participate in workplace.

The blue economy is characterized by a paradigm shift towards sustainable use of ocean resources for economic growth, improved livelihoods and ecosystem health. It encompasses diverse sectors such as fisheries, aquaculture, maritime transport, coastal tourism, offshore renewable energy and marine biotechnology. The sustainability and inclusivity of blue economy are contingent upon addressing the persistent gender inequalities that permeate these industries. In spite of being traditionally male-dominated industries, the blue economy offers diverse opportunities for women's participation and empowerment. Although women have significant involvement in various activities across the value chain, women's contributions to the blue economy have often been overlooked. This study argues that integrating a gender perspective into blue economy frameworks is not only a matter of equity but also a strategic imperative for achieving sustainable and inclusive development goals. By empowering women and ensuring their equal participation, the blue economy can unlock its full potential and contribute to broader societal well-being.

However, the participation of women in most of the blue economy industries remain significantly low due to several barriers. Some of these barriers are common across the industries while industry specific barriers also persist. Although the primary focus of this review remains on women participation in seafaring profession, in this review, we will explore the multifaceted dimensions of women's involvement in various blue economy industries, their current status, and future prospects.

2.5.1 Fisheries and aquaculture are essential components of the blue economy, providing livelihoods for millions of people worldwide. Historically, women have played a vital role in fisheries and aquaculture industry, particularly in processing and trade while men dominated capturing fishes. Recent statistics of FAO (Food and Agriculture Organization) shows that women now account for nearly 50% of the workforce in aquaculture, largely due to the growth of small-scale and inland aquaculture enterprises.

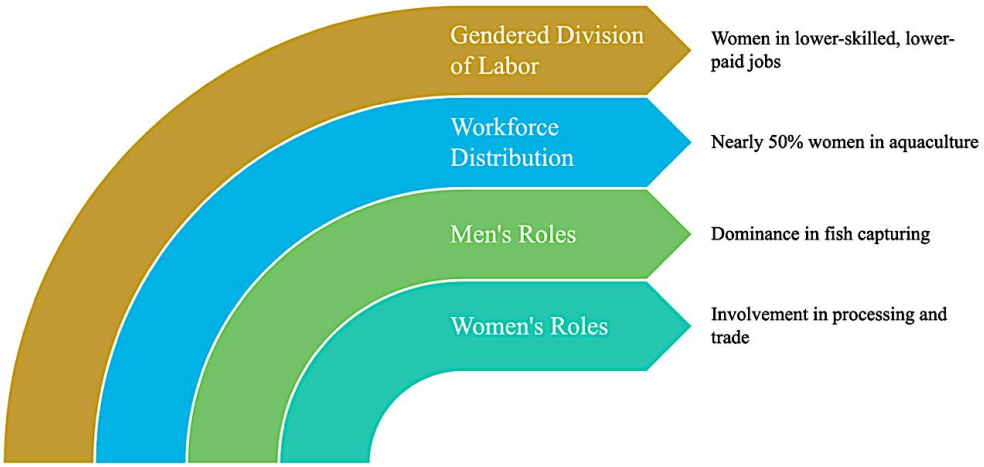


Figure 6: Gender dynamics in fisheries and aquaculture
(Sources: *Prepared by authors based on data from previous studies)*

However, the division of labor in fisheries and aquaculture is often highly gendered with women concentrated in lower-skilled and lower-paid activities. Men dominate primary production while women are more likely to be involved in post-harvest activities (World Economic Forum, 2024). This gendered division of labor is influenced by a range of factors, such as cultural norms and access to credit, technologies, and training. Despite these

challenges, women make significant contributions to fisheries and aquaculture as well as their participation in this industry is relatively higher than other blue economy sectors.

2.5.2 Coastal tourism is a significant contributor to the blue economy, offering diverse employment opportunities for women. Women play a significant role in the economic development of coastal and marine tourism. Their contributions span various sectors, including ecotourism, hospitality, handicraft production, and small-scale fisheries. Women in Maluku, Indonesia, actively engage in ecotourism by managing homestays, producing traditional handicrafts, and guiding tours. Their efforts not only contribute to the local economy but also promote cultural preservation (Afdhal, 2023). Similarly, in the Mekong Delta, Vietnam, women's participation in homestay tourism has generated additional income, strengthened family ties, and reduced domestic violence (Quang et al., 2023). In many coastal communities, women produce traditional handicrafts and local culinary products, which are sold to tourists. For instance, in Mandeh, Sumatera Barat, women utilize local marine resources to create environmentally friendly products, contributing to sustainable tourism development (Fatimah, 2022). Women in coastal areas are also integral to the fisheries supply chain. In Pamekasan, Indonesia, women assist in marketing, gear repair, and processing crab catches, significantly contributing to household income (Qomariyah et al., 2024). Similarly, in West Africa, women dominate the shellfisheries value chain, with over 50,000 women harvesters contributing to an annual harvest valued at USD 336 million (Chuku et al., 2022). Besides, Manafe et al. (2024) reported that women in Kupang City, Indonesia, have benefited from digital entrepreneurship training, enabling them to market their culinary products and manage finances more effectively. However, women's involvement in this sector is often concentrated in low-skilled and low-paying jobs, reinforcing traditional gender roles and stereotypes. Challenges such as limited access to capital and business knowledge also persist (Pavlović et al., 2022).

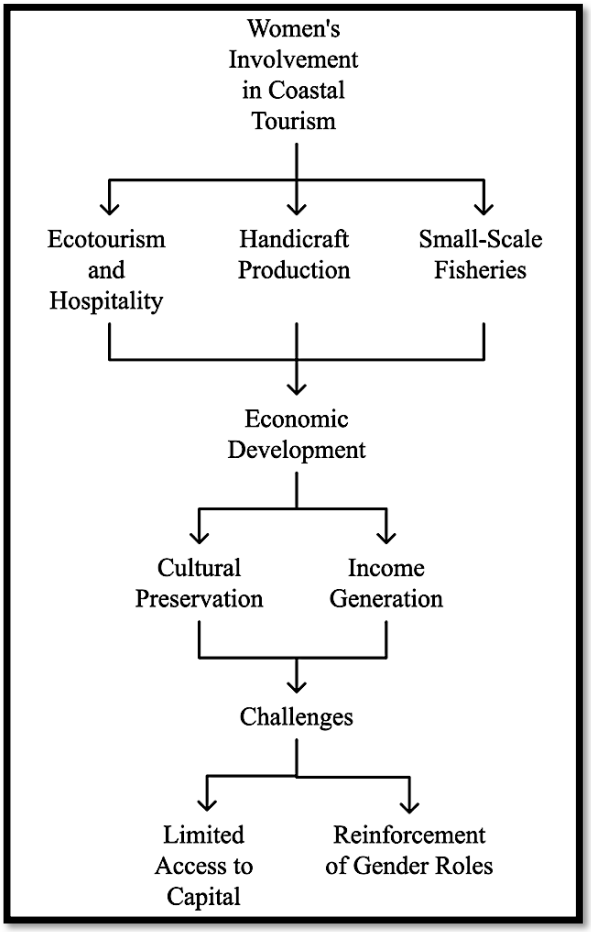


Figure 7: Women's Contribution and challenges in coastal tourism

(Sources: Prepared by authors based on data from previous studies)

In fine, women's participation in coastal and marine tourism is vital for the sustainable development of this sector. Their contributions span economic, socio-ecological, and cultural domains, highlighting their importance as key stakeholders. However, challenges such as gender roles, lack of resources, and governance issues persist. By addressing these challenges through gender-inclusive policies, capacity building, and support for women-led initiatives, the tourism sector can become more equitable and sustainable. The case studies from regions such as Maluku, West Africa, and Kerala demonstrate the potential for women's empowerment and the positive impacts of their participation on local economies and environments.

2.5.3 The offshore renewable energy sector, including offshore wind, tidal, and wave energy, is a rapidly expanding industry. This sector, particularly wind energy, has seen significant growth in recent years, driven by the global push towards sustainable energy solutions. However, the participation of women in this sector remains a critical area of discussion, especially in the context of gender equality and workforce diversity. However, the global percentage of women participating in this sector is not well-explored in the present literature. According to World Wide Fund (WWF) report in 2023, women constitute just 21% of the workforce in the global wind energy sector (both on- and offshore). This figure, however, includes both onshore and offshore segments and

does not provide a breakdown specific to offshore renewable energy. The report also states that the gender-disparity of wages is nearly 20% and women only occupy up to 20% of senior roles in the EU energy sector. While there is no specific data for the offshore sector, regional studies suggest variations in women's participation. For instance, in Europe, the gender balance in the energy sector varies by country, with some nations like Estonia, Slovenia, and Belgium performing better in terms of gender equality (Henriques et al., 2024). These regional differences could imply that women's participation in the offshore sector might also vary significantly by region.

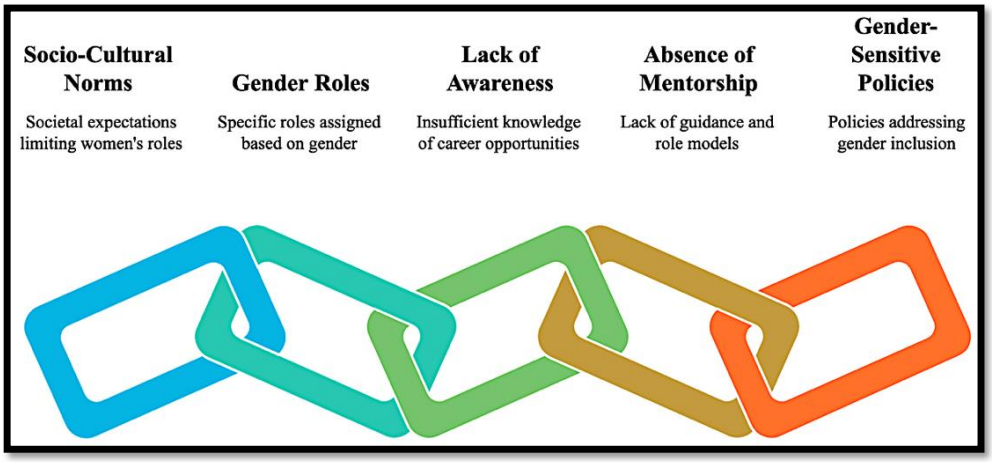


Figure 8: Barriers to women's participation in Offshore renewable energy

(Sources: Prepared by authors based on data from previous studies)

Socio-cultural norms and gender roles often limit women's participation in male-dominated industries like offshore renewable energy. These barriers are deeply rooted in societal structures and can hinder women's access to education, training, and employment opportunities in this sector (Baruah, 2017; Erten et al., 2024). Moreover, Karakislak et al. (2023) and Noronha et al. (2024) argued that the lack of awareness about career opportunities in the offshore renewable energy sector among women is a significant challenge. Additionally, the absence of mentorship programs and role models can discourage women from pursuing careers in this field. Bagdi et al. (2023) highlighted the absence of gender-sensitive policies in the energy sector as a critical barrier as many countries lack policies that specifically address the inclusion of women in the renewable energy workforce, including the offshore segment. As a result, addressing these socio-cultural, policy, and educational barriers is essential to increasing women's participation. By implementing targeted strategies, the offshore renewable energy sector can become more inclusive, leading to a more diverse and equitable workforce.

2.5.4 The shipping and logistics sectors have seen slow progress in gender diversity. Women represent only around 2% of the global seafarers. While shore-based maritime roles, such as in ports and logistics companies, have witnessed increased female participation, on-board roles remain largely inaccessible due to gender biases, safety concerns, and inadequate infrastructure for female seafarers. A detailed discussion on women's participation in these sectors is given below.

2.6 Women's Participation in the Maritime Industry

Although the traditionally male-dominated maritime industry has seen gradual shifts in women's participation over the years, the rate of participation remains significantly low, highlighting significant gender gap. Currently, women constitute only about 1.28% of the total seafaring population globally with the majority employed in catering and hotel sections on cruise ships and ferries (Ashok Srinivasan, 2021; Narayanan, Emad and Fei, 2023). (Kitada, 2021) argued that these roles are often seen as more suited to women due to societal perceptions of their suitability for such tasks. Several studies (Ashok Srinivasan, 2021; Kitada, 2021; Narayanan, Emad and Fei, 2023) showed that women hold less than 5% of leadership positions in the maritime industry due to several challenges including limited access to training, lack of female role models, and traditional social and industry norms. Women's representation in leadership roles remains disproportionately low, highlighting a significant gender gap in decision-making roles (Narayanan, Emad and Fei, 2023; Grimett, 2024; Lyu and Li, 2024). Although this figure varies across countries, the overall proposition remains unchanged. For instance, only 2% of seafarers are women in Japan and less than 10% of shipping companies actively promote female employment (Ishida, 2022). Women often face stereotypes that perceive them as less suited for technical roles, leading to limited access to vocational training and employment opportunities (Kitada, 2021; Lyu and Li, 2024). The demanding nature of maritime careers, including long periods at sea, conflicts with traditional family responsibilities, creating a barrier for women, especially for mothers ((Menhat and Mateo-Babiano, no date; Narayanan, Emad and Fei, 2023). Moreover, women seafarers frequently experience sexual harassment and bullying with inadequate support systems to address these issues (Kitada, 2021; Narayanan, Emad and Fei, 2023). Furthermore, (Kitada, 2021; Narayanan, Emad and Fei, 2023) also highlighted that women face specific health challenges due to physiological differences and inadequate access to medical care onboard ships.

Recently, the "IMO-WISTA Women in Maritime Survey 2024 Report" reveals a global landscape where women remain significantly underrepresented in the maritime sector yet show notable progress in specific administrative and institutional roles. While women constitute approximately 18.90% of the overall maritime public sector workforce, their representation in key areas like diplomatic staff, IMO representatives, Search and Rescue (SAR) services, and government-owned ports and terminals has seen an upward trend between 2021 and 2024, with increases to 28%, 15%, and 25% respectively in certain categories. However, this progress is not uniform, as evidenced by a slight decline in women customs staff to 16% and a concerning lack of junior women (18-24 age category) in the public sector workforce, suggesting systemic recruitment issues. Critically, in the private sector, women account for only 19.99% of the total workforce and represent a stark 1% of the active seafaring workforce, with persistent discriminatory hiring practices still evident, such as companies explicitly stating they "do not hire women in offshore support vessels". The report underscores that while progress has been noted, the persistent disparities highlight an urgent need to move beyond mere dialogue to decisive implementation and fundamental cultural change within the industry.

Efforts to address this imbalance are underway, notably through the International Maritime Organization's Women in Maritime Initiative. This initiative aims to empower women and promote gender equality in maritime careers. Additionally, there is a growing trend of women assuming leadership positions within the industry which is crucial for driving change and fostering a more inclusive environment. The Pacific Women in Maritime Organization (PACWIMA) has also been instrumental in promoting gender equality in Fiji, addressing issues like sexual harassment and increasing female participation (Ningrum Surya Ningsi Pratiwi, 2024). The International Labour Organization (ILO) advocates for amendments to legal instruments, such as the Maritime Labour Convention, to reduce the gender gap in seafaring careers (Dragomir and Popa, 2018). To further

enhance women's participation, targeted educational programs and training initiatives are essential, focusing on technical fields like engineering and navigation. Maritime colleges are implementing programs to train female students for leadership roles, emphasizing the importance of gender sensitivity and inclusivity (Ishida, 2022).

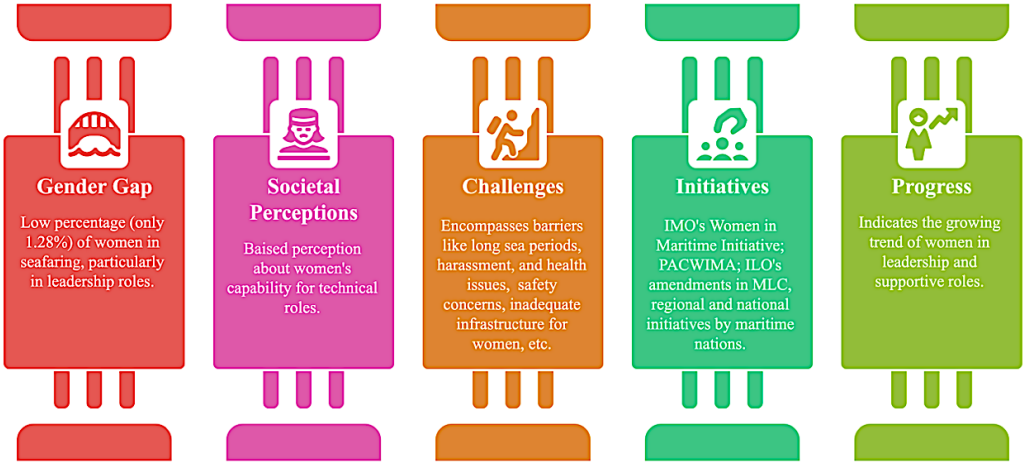


Figure 9: Navigating gender equality in maritime industry
***(Sources:** Prepared by authors based on data from previous studies)*

In addition, **several case studies** highlight the initiatives and their positive impact on women participation in maritime industry. Several investigations (Melkas and Anker, 2003; Bordoloi and Das, 2017; Ikeda, 2019) highlighted the case studies from Norway, Japan, and Singapore, showcasing strategies for advancing gender equity through inclusivity policies and digitalization. These countries demonstrate how targeted initiatives can enhance women's participation and leadership in the maritime sector. The studies also emphasize the need for strategies like the Gender-Responsive Maritime Strategies (GReMS) framework to promote gender equity and enhance women's roles in the maritime industry. Similarly, (Tanrıverdi and Kavurmacı, 2023) examined perceptions of women in port management in the South Marmara region of Turkey. The study found that the majority of participants rejected the notion that the sector is unsuitable for women, and there was no significant difference in perceptions between managerial and officer levels. This suggests a positive shift in attitudes toward women's roles in the maritime sector. (Menhat and Mateo-Babiano, no date) drew data from interviews with women in executive and top management positions in Malaysia, Australia, and the Philippines, highlighting the challenges faced by women in these roles and the need for more comprehensive empowerment initiatives. Besides, countries like South Africa and Namibia are adopting gender-responsive budgeting to address capacity-building gaps for women in the maritime sector (Osundiran, 2024). Hence, it can be concluded that while progress is being made, significant work remains to be done to achieve gender parity in the maritime sector.

The integration of automation and digital technologies presents both challenges and opportunities for women, potentially opening new roles but also risking job displacement in traditional sectors (Kim *et al.*, 2019). The shift towards sustainable practices offers opportunities for women to contribute to innovation and governance in the maritime industry as suggested by (Kim *et al.*, 2019). International frameworks like the United Nations Sustainable Development Goal 5 (SDG 5) and initiatives by organizations like the IMO are driving efforts to mainstream gender equality in maritime policies (Kitada, 2021; Pike *et al.*, 2021; Lyu and Li, 2024). Organizations like the International Transport Workers' Federation (ITF) are actively supporting women transport workers

through union organizing, leadership development and addressing gender-based violence Moreover, there is a growing emphasis on improving gender-related data collection in the ports and shipping industry to inform evidence-based policies and track progress towards gender equality.

The above discussion and statistics conclude that the maritime industry is at a crossroads, with increasing recognition of the need for gender equality to enhance its resilience and sustainability. While significant challenges persist, the collective efforts of organizations, governments, and individuals are paving the way for a more inclusive future. Addressing these issues comprehensively will not only empower women but also strengthen the global competitiveness and operational efficiency of maritime industry. Hence, this study aims to explore the pressing challenges of women participation in maritime industry, particularly at leadership positions. This study also explores the impact of digitalization and automation on women's participation and formulates an action plan to ensure gender parity in the highly digitalized future shipping industry. The next section highlights the challenges of women's participation in maritime industry in details that has been discuss above in brief. Some points might seem repeatedly mentioned, however, a conscious effort has been made to discuss those issues comprehensively.

2.7 Challenges of Women's Participation in Maritime Industry

Women captained ships as early as 1603, and during World War II, some even commanded warships (Anon, 2003). However, despite such early achievements, the maritime and shipping industries have remained heavily male-dominated. Even amid global efforts to promote gender equality, women still struggle to break into and sustain careers in this sector. For instance, Baltic and International Maritime Council (BIMCO) and International Chamber of Shipping (2021) reported that women still constitute a very small fraction of the global maritime workforce. Of the world's 1.9 million seafarers, only 24,059 are STCW-certified women, representing just 1.28%. In UK as of 2019, women made up only 3.23% of the global seafaring workforce (DoT, 2018). Furthermore, while recent trends suggest slight improvements, where 10% of new SMarT (Support for Maritime Training) entrants in 2018-19 were female, up from 5% the previous year (DoT, 2019) however the progress remains slow. In some regions, the disparity is even starker. For example, in China, only 33 women are STCW-certified to work on international ships, which amounts to a mere 0.0132% of the workforce (Lyu & Li, 2023) significantly lower than the UK's 3% in 2019 (DoT, 2019). In contrast, traditional maritime countries like Sweden have made more progress, with women comprising 13-19% of their seafarers (Nastalli & Bartlett, 2022). Nevertheless, women remain vastly underrepresented in higher-ranking roles, particularly in the deck and engine departments, despite the fact that the maritime industry continues to face an officer shortage projected to reach 89,510 by 2026 (BIMCO/ ICS, 2021, Narayanan, Emad, & Fei, 2023).

Moreover, the gender gap in the maritime industry extends beyond seafaring. Across various subsectors, such as ports and logistics, women are similarly underrepresented (Acejo & Abila, 2016; Ahmad et al., 2020). Lee et al., (2022) found that women in Taiwan have less economic power and decision-making rights than men do; In Brazil, Medeiros et al., (2021) revealed that the women have limited chances to get international career opportunities despite various measures. While Halimaha et al., (2019) identifies significant barriers to women's participation in ports of Malysia. Medeiros et al., (2019) mapped the Brazilian maritime industry and observe that women remain vastly underrepresented in leadership roles, despite efforts to close gender gaps. Each of these regional examples demonstrate that how deeply ingrained cultural and organizational practices hamper efforts to achieve gender equality in the maritime sector.

While some industries have advanced over the years in areas like law and medicine (Silbey, 2016) the transportation, logistics, and infrastructure sectors—including maritime—have been slow to evolve. Still, women occupy only 40% of managerial positions and mere 15% of C-suite positions in these industries (McKinsey, 2020). In addition, the few women who make it to leadership positions are usually restricted to overseeing the support functions, and not operational ones (Ortega et al., 2015; Vo et al., 2018), This constraint reinforces their marginalization in key decision-making positions. Despite progress in sectors like naval forces, where women now represent 10-20% of the workforce, similar advancements have not been achieved worldwide (Council on Foreign Relations, 2020, Statista, 2021). For instance, in countries like Somalia, cultural resistance remains strong. Despite a Somali woman joining the coast guard in 2016 and later leading training efforts, women's participation in maritime security is still met with skepticism. Indeed, some Somali officials have ridiculed the idea of women engaging in counter-piracy operations, reinforcing the stereotype that maritime security is a male domain (Becker-Weinberg, 2019, Chapsos & Norman, 2023).

Similarly, ocean science is shaped by male-dominated cultures, with women often facing misogyny, tokenism, harassment, and microaggressions (Amon et al., 2022; Carballo Pineiro & Kitada, 2020). Women make up 38% of marine scientists (IOC-UNESCO, 2020), but this may be overstated (Sun et al., 2021), and their numbers drop sharply at senior levels, following the "leaky pipeline" trend (Etzkowitz et al., 1994), the "vanishing box" (Etzkowitz & Ranga, 2011), and the "braided river," which highlights non-linear career paths and challenges in re-entry (Batchelor et al., 2021). For example, in Kenya, female leadership remains low (Ojwala et al., 2022), Similarly, China's largest shipping company has ceased hiring women for cargo ships, despite previous efforts at inclusion (Chin, 2008).

Nonetheless, recent studies show that gender diversity enhances organizational profitability. For example, Bannò & Nicolardi (2020) showed that increased gender diversity in the top management leads to improved organizational financial performance. Likewise, similarly, research indicates that women may favor sustainable practices. For example, women leading artisanal fisheries in Brazil upheld high sustainability standards in resource management (Gissi et al., 2018, Fonseca et al., 2016) However, the maritime industry lags in promoting women to leadership roles. Female representation remains low, both on ships and in port operations (Acejo & Abila, 2016; Ahmad et al., 2020). Moreover, there are still exhibited gaps in wages. For example, in the Port of Antwerp, for example, women are underrepresented in full-time positions. Age also plays a role, with most older employees being male, further widening the wage gap (Esser et al., 2020). This empirical study highlights large wage differences, an important issue, which is less examined in maritime research (García-Echalar et al., 2024). Although many maritime organizations recognize the importance of gender diversity for profitability, the number of actionable measures is still quite low, and research on gender diversity remain limited. For example, a search for articles through Scopus™ made in June of 2023 generated only five articles addressing gender discrimination in maritime calling for more studies and data in this area (Stavroulakis et al., 2024).

Beyond these structural barriers, a lack of awareness about maritime careers also plays a role in the industry's gender imbalance. For instance, the shipping industry is far less visible to young women compared to more prominent sectors like IT, economics, and medicine (Lyu & Li, 2023). Even though Chinese maritime institutions have opened seafaring-related majors to women since 2014, only 12.55% of female graduates from Shanghai Maritime University obtained competency certificates, which significantly limits their career opportunities (Zhang & Zhao, 2015). Moreover, language barriers pose a major obstacle. Proficiency in Maritime English is critical for safety at sea, with communication failures accounting for 30-42% of shipping accidents

(Trenker, 2000). Yet, nearly two-thirds of maritime students fail their Maritime English competency exams, and 86.5% of surveyed female cadets indicate that they do not plan to work onboard after graduation due to these and other challenges (Lyu & Li, 2023).

Although working at sea involves physical and psychological challenges, such as cramped living conditions, seasickness, and isolation, these are not inherently more deterrent for women than for men (Johannesen et al., 2022). Instead, the real obstacles lie in societal attitudes, cultural resistance, and a lack of effective gender-sensitive policies. While seafaring is widely recognized as one of the most hazardous professions, with significant mental and physical health risks (Carol-Dekker & Sultan, 2016; Chung et al., 2017; Lefkowitz & Slade, 2019), the underrepresentation of women in this industry speaks more to institutional and cultural barriers than to the dangers of the job itself (Johannesen et al., 2022).

One of the most pressing issues women face in the maritime industry is sexual harassment, which female cadets rank as a primary concern before starting their training. Approximately one in six women report experiencing or witnessing harassment during their first sea voyages (Dragomir et al., 2018). Additionally, the indirect impacts of maritime crime, such as piracy, also disproportionately affect women. For instance, in Somalia, pirate groups exploit women through forced sex work and sham marriages (Chapsos & Norman, 2023, Arvanitis et al., 2011). Moreover, the families of male hostages often suffer trauma, with wives experiencing Post-Traumatic Stress Disorder (PTSD) and communities losing their working-age men to death or imprisonment (Seyle, 2016).

Furthermore, the career demands of seafaring, including long separations from family, disproportionately affect women, especially those in leadership roles, many of whom remain single due to the difficulties of balancing personal and professional lives (Dragomir et al., 2018). Retention is another crucial issue. Indeed, women who enter the maritime workforce often do not stay for long. Discrimination, safety concerns, and limited opportunities for career advancement contribute to high turnover rates among female seafarers (Belcher et al., 2003; Thomas, 2004; European Commission, 2020).

Wage gaps also persist, with women earning significantly less than men in comparable roles (Arvanitis et al., 2011). Yet, studies show that increasing female participation, particularly in leadership roles, can improve business performance. Research indicates that companies with at least one woman on their board have shown better share price performance than those without (ILO, 2015, Mahabir-Lee & Rambarath-Parasram, 2019). These finding emphasizes the positive economic impact of female leadership in the corporate sector, which likely extends to the maritime industry as well. Nevertheless, progress in this area remains slow (Bannò & Nicolardi, 2020; Luh & Kusi, 2023; Sun et al., 2021). This issue is further complicated by the prevalence of Flags of Convenience (FOC) vessels, which operate under lax labor laws and exploit lower-paid seafarers. In particular, women, especially younger seafarers, are vulnerable to exploitation in these roles (George, 2011; ITF Seafarers, 2012). For example, physical strength requirements are often used to exclude women, as seen when weight-lifting limits were cited on a polar research cruise (Harvey, 2020). Similarly, underrepresentation persists in fisheries; only one female observer works with the Pacific Islands Forum Fisheries Agency (FFA, 2019), and 12.5% of women in Alaska's observer program reported harassment (Wang & DiCosimo, 2019).



Figure 10: Barriers to Women's Participation in Seafaring Profession

Despite some progress, the maritime industry continues to reflect entrenched gender inequalities. Therefore, to bridge these gaps, significant changes are needed, not only in policies and laws but also in cultural attitudes that reinforce stereotypes. While the growing demand for seafarers may create more opportunities for women, without a concerted effort to tackle systemic barriers, the industry's progress will remain slow. Ultimately, expanding women's participation in the maritime sector is not only a matter of equity but also of economic and operational performance, as research shows that gender diversity improves business outcomes. To accomplish this there is the need to address the structural in equalities which has kept women to the periphery of the maritime workforce scene.

2.7.1 Harassment and Safety Risks at Sea: Workplace harassment and gender discrimination in the maritime industry with particularly against women still are persistent and widespread. Moreover, the nature of life at sea exacerbates this vulnerability, as crew members face prolonged periods of isolation, cut off from reliable communication tools like Inmarsat and V-Sat for women, who are already underrepresented on ships. This isolation is further compounded by their heightened visibility within male-dominated crews, intensifying feelings of discomfort and exposure (Lyu & Li, 2023). For instance, a 2020 Gender Diversity Survey revealed that 66% of 1,128 women from 78 countries reported experiencing harassment or intimidation by male colleagues (Anglo-Eastern Maritime Training Centre, 2022). Similarly, a Nautilus survey found that 79% of those who had faced

bullying, discrimination, or harassment reported negative effects on their morale and job performance (Nautilus, 2010).

Despite the frequency of these incidents, underreporting of harassment remains rampant. This issue is most conspicuous when the victim is a subordinate worker or when bullying is done by the senior employees (Hoel & Vartia, 2018). Women still have individual strategies to deal with the harassment, such as ignoring the harassment or avoiding the perpetrator, rather than filing formal complaints (Seedat-Khan et al., 2020). As Fitzgerald Gold et al. (1995) observed, seeking institutional remedies is usually considered a last resort, reflecting a broader maritime culture that is resistant to addressing these problems. As a result, this reluctance discourages women from entering or continuing in seafaring careers, especially when they experience harassment early in their professional lives (Carballo Pineiro & Kitada, 2020).

Harassment at sea takes various forms, including verbal, non-verbal, and physical misconduct. Common examples include sexist jokes, unsolicited comments, and inappropriate advances. In some cases, male colleagues have exposed themselves, sent love letters, or made unwanted visits to female cabins. For example, the authors documented instances where male crew members attempted to kiss, hug, or inappropriately touch women at work (Stevenson, 2015, Kitada, 2010). For instance, some women do not recognize certain verbal or non-verbal behaviors as harassment, while others modify their clothing or body language to downplay their gender. Further highlighting the severity, reports of male crew members sharing pornographic material, making unwanted visits to female cabins, and incidents of rape or attempted rape have emerged (Cress, 2018, Carballo Pineiro & Kitada, 2020). In the UK, a study found that over half of female respondents had faced harassment at work, with many enduring repeated sexual jokes (TUC, 2016).

In order not to be harassed, women alter their appearance, downplaying their femininity to deflect unwanted attention (Carballo Pineiro & Kitada, 2020). They often withdraw from social interactions as a form of self-protection (Kitada, 2010), and this withdrawal, combined with the stress of enduring harassment, increases their risk of physical accidents (Pike et al., 2021) Nevertheless, these tactics do not work well in shielding them from inappropriate behavior. Isolation at sea further intensifies the mental and emotional toll of harassment. In turn, this social withdrawal destabilizes the ship's work environment, posing broader risks to crew safety, vessel operations, cargo, and even the environment (van der Klauw et al., 2016). Additionally, workload, fatigue, and outdated technology contribute to shaping the social environment onboard. For instance, a year 2019 SAFETY4SEA poll revealed that 38% of respondents cited workload and fatigue as barriers to social interaction, with another 19% pointing to a lack of internet access (Lyu & Li, 2023). In addition, it has been found that designs of ships do not consider women’s requirements; in fact, the convention of Maritime Labor even demands gendered facilities. For example, the average height of Chinese women, at 158 cm, shows how ship layouts often ignore basic ergonomic considerations (Lyu & Li, 2023). Similarly, Personal protective equipment (PPE), often designed for men, must be appropriately fitted for women to ensure safety (Criado-Perez, 2019)

The issue of harassment in the maritime industry also reflects structural and cultural barriers that deter women from fully participating in the field. As noted by the International Labour Organization (ILO), sexual harassment undermines women’s involvement in male-dominated industries like shipping (Stavroulakis et al., 2024). Moreover, it is well-known that over 90% of women in the maritime industry experience sexual harassment at some point in their professional lives (Equality and Human Rights Commission, 2020). These patterns accord with other research studies from other occupation fields indicating that between one quarter to over three quarters of all women globally experience workplace: sexual harassment (Feldblum & Lipnic, 2016). The common

findings are that such low participation rates are caused by broad recruitment barriers in addition to other structural conditions. Studies by Bhirugnath-Bhookhun & Kitada (2017), Ruel et al. (2020), and Radcliffe & Cassell (2015) highlight work-family conflict as a major issue. Women in maritime face increased pressure from institutions and cultural gender stereotyping, particularly women being labelled as caregivers. In addition to recruitment barriers, broader structural issues contribute to these low participation rates. Bhirugnath-Bhookhun & Kitada (2017) highlights how women in maritime often struggle to balance work and family responsibilities, while Ruel et al. (2020) and Radcliffe & Cassell (2015) emphasize how institutional pressures and gender stereotypes—such as viewing women as primary caregivers—worsen these challenges, leading to work-family conflicts and limiting career advancement. Without significant structural changes and cultural shifts, the perpetual cycle of isolation, increased vulnerability and harassment will continue. Eventually, these barriers will be detrimental to women's protection, their professional advancement and overall well-being in this important sector of the economy.

2.7.2 Wage Disparities: Wage disparity is another pervasive issue in the maritime sector, with women earning significantly less than their male counterparts (Kormych, 2020, Arvanitis et al., 2011). For example, in the UK, major shipping companies highlight this imbalance starkly. At NYK Group (Europe) Ltd., women earn just 60.5 pence for every pound earned by their male counterparts, while at Carnival Plc, the world's largest cruise operator, the figure is 61.6 pence per pound. The disparity is even more extreme at V.Ships UK Ltd., where women make only 51.6 pence per pound (Kelly, 2018). These statistics underscore the persistent pay gap, mirroring patterns seen in other male-dominated sectors such as construction and logistics, where work-life balance, underrepresentation, and unconscious bias remain prevalent (Nix & Stiffler, 2016).

Even when women are employed, biases persist. Companies often perceive hiring women as economically burdensome, arguing that women take longer to adjust to the male-dominated work environment (Lyu & Li, 2023). Additionally, concerns about higher turnover due to maternity leave further deter companies from employing women (Ryals, 2023, Anuar, Khairi, & Ahmad, 2022). However, measures like requiring two men to enter a female colleague's cabin for safety can intensify distrust and lead to hostility at work between genders (Zhao, 1998, Lyu & Li 2023). Despite increasing awareness to the realization that diversity benefits, the sector remains one of the least inclusive with women remain to be faced with challenges especially on matters concerning pay and working conditions.

2.7.3 Hegemonic Masculinity and Cultural Reinforcement: At the root of these inequalities lies the maritime industry's deep culture of "hegemonic masculinity" (Connell & Messerschmidt, 2005), which perpetuates preservation of patriarchal values. This cultural framework not only influences workplace dynamics but extends beyond the work environment, shaping social behaviors even one's private life (Goffman, 1959). In addition, language plays a powerful role in reinforcing these gender norms, such as the words like "seaman" and "first mate" sealing the masculinity of the sector. Although the International Maritime Organization (IMO) has made efforts to adopt gender-neutral terms such as using "seafarer" and "chief officer," these linguistic shifts have been slow to take root (Lyu & Li, 2023).

2.7.4 Career Constraints Due to Family Responsibilities: In terms of career progression, the occupational choice of women seafarers is limited by family circumstances, particularly as they approach the senior roles. Generally, they require 6- 8 years to be promoted and get a position of chief officer or second engineer.

At this point, most women re considering marriage and starting families, making it more difficult for them to continue in shipboard roles (Lyu and Li, 2023). Moreover, pregnancy complicates career progression further, as long work cycles, physically demanding tasks, and limited medical support on board lead companies to hesitate in hiring young women (Seedat-Khan et al., 2020, Jones et al., 2019). Single mothers, in particular, face immense challenges in the maritime sector, where unconscious bias often frames women as caregivers first, thereby limiting their career prospects (Vo et al., 2021).

2.7.5 Career Limitations: The "Leaky Pipeline": Deep-seated cultural and gender prejudices about what may be seen as “acceptable role” for women still exist to sustain the “leaky pipeline problem”, where competent women drop out of maritime industry before reaching senior positions (Lavissiere et al., 2019). In many cases, career progression in maritime is more closely tied to gender than professional merit (Ruel & Jaegler, 2021). This trend is evident in the UK, where 82% of seafarers are male, and women face challenges like cultural stereotyping, inadequate safety measures, discrimination, and harassment ((Department for Transport, 2022, (Cai et al., 2023). As a result, these workplace conditions severely restrict women’s career advancement, leaving few able to ascend to senior positions (Kinthaert, 2017). Sexual harassment, in particular, remains a significant factor deterring women from entering or staying in maritime careers (Carballo Piñeiro & Kitada, 2020).

2.7.6 Company Policies and Unfavorable Workplace Conditions: Shipping companies are often hesitant to hire women, citing concerns about maternity leave and the perceived operational costs associated with employing female crew members (Lyu & Li, 2023). This is especially true in flag-of-convenience (FOC) states, where loopholes in labor laws allow companies to bypass minimum wage and labor protections (Sharda, 2012; Smita, 2011). While some UK companies are motivated by diversity policies (Pike et al., 2017), barriers to gender equality remain widespread, and many firms still view hiring women as a short-term solution rather than part of a long-term strategy to address labor shortages and promote gender parity (Kim et al., 2019), as outlined in Sustainable Development Goal 5 (UNCTAD, 2018).

Moreover, ship design in the maritime sector continues to pose significant challenges for women, as most vessels are traditionally designed with male crew members in mind. This leads to cramped spaces that increase the risk of harassment and fail to meet women’s sanitary needs (Anglo-Eastern, 2017). In fact, gender-sensitive perspectives are frequently overlooked, as seen in the European Marine Board's report, which neglects to consider gender-specific requirements in ship design (Nieuwejaar et al., 2019). For example, while performing certain activities like sorting catches or lifting heavy equipment become a challenge for women due to these design flaws, and retrofitting ships to accommodate their needs is expensive and time-consuming (Criado-Perez, 2019)

2.7.7 Physical and Psychological Health Challenges for Women Seafarers: The adverse effects of working for a long time in confined spaces pose unique problems to women seafarers. It clearly shows that many women experience fatigue, rheumatism, menstrual disorders or inadequate medical care including gynecological services (Lyu & Li, 2023). For example, the Women Seafarers’ Health and Welfare Survey which has proposed simple interventions such as supplying female-centered health information, gynecological drugs, and better access to feminine hygiene products and amenities on ships to take care of women in the course of their travels (Stannard et al., 2015).

2.7.8 Intersectionality and Compounded Disadvantages in Maritime: Gender, race, and nationality as the three intertwined diversity dimensions-further amplify the problem of gender inequality in the maritime sector. Cultural differences add complexity, because the perception of harassment differs from culture to culture. This makes it nearly impossible to solve on the ships which in fact create an isolated microcosm (Carballo Pineiro & Kitada, 2020). For its origin is rooted in Black feminism, intersectionality is a theory and praxis dedicated to the functioning of social phenomena caused by overlapping systems of oppression (such as gender, race, ethnicity, and the like). In the maritime autonomous sector these discriminations often affect the minority and the marginalized groups like the women, the ethnic groups, the LGBTQIA+ individuals and many others. For instance, there is a notable disparity among female non-UK officers (2% out of 3% total), who often come from countries like Poland, the Philippines, and India. Cai et al., (2023) opined that gender and race can worsen structural vulnerability for those people, but this factor is not well investigated. Furthermore, shipping is still widely seen as a "boy's club," fostering a culture that marginalizes not only women but also other underrepresented groups, such as ethnic minorities, LGBTQIA+ individuals, and those with disabilities (Tansey, 2015; Maritime UK, n.d.) While although data on these marginalized groups in the maritime sector is limited, the intersectionality of their identities often compounds the barriers they face (Stavroulakis et al., 2024; Parnell et al., 2022).

2.7.9 Educational Inequalities and Limited Training Opportunities: The major challenge that hampers the participation of women in the maritime industry is unequal access to education and specialized training. Girls in most of the developing nations have limited education access than for boys, and the difference is even higher when it comes to maritime-related training programs. For instance, some training institutions for the seafarer cadet in the non-OECD countries does not accept female applicants at all, thereby excluding women from any chance of attaining maritime employment positions (Pike et al., 2017). Furthermore, the high costs associated with cadet training, which requires specialized and expensive equipment, present an additional obstacle. Another barrier is the cost of the equipment associated with cadet training. On the other hand, the cadets in the OECD countries often benefit from government or corporate sponsorships that help subsidize these expenses (Frazer-Nash Consultancy, 2017; Tang & Zhang, 2021). Thus, women from more impoverished areas feel discouraged from doing employment in such careers indicating that they cannot afford to get the right qualification that they desire (Tang, 2023).

2.7.10 Employment Inequality and Regional Disparities: Employment inequality also severely restricts women's access to maritime roles, with stark regional disparities in gender representation. For example, Western Europe is most advanced in introducing gender equality to navigation, due to continually advancing policies for diversity at sea. It is worth to reveal that the countries like the United Kingdom and Denmark have registered higher percentage of women seafarers as a result of the proactive recruitment strategies (DfT, 2019; Bakhsh, 2020). Nevertheless, in other areas like Asia and Africa, cultural perceptions favor male hegemony further entrenching gender imbalances to retaining the viewpoint that sailing as a male occupation. In nations such as Philippines and India, traditional patriarchal cultural norms and gender stereotyping makes the shipping companies to avoid recruiting women thus perpetuating existing gender gaps (Tangi, 2016, Gupta, 2021). Even some recruitment companies openly refuse to hire women to work on merchant ship (Belev et al., 2020).

2.7.11 Globalization and Flags of Convenience: Globalization of the shipping industry mainly through the Flags of Convenience (FOC) adds another layer of complexity to gender disparities. The shipping industry is focused on reducing costs, which means hiring cheaper foreign seafarers. This market mechanism limits opportunities for Taiwanese women, who already face gender bias (Guo, 2019). Another aspect is that ships from the traditional maritime countries as the UK and Japan are often registered in the low-cost states including Panama and Liberia, creating a global labor market for seafarers (ILO, 2001). As a result, these FOC ships hire crew members from labor-supply nations such as the Philippines, China, India, and Eastern Europe. While this system globalizes the workforce, women seafarers from developing countries face additional barriers shaped by their national contexts (Tang, 2023). Furthermore, the gender equality challenges in maritime are not uniform; they vary significantly based on the socio-economic and cultural environments of the seafarers' home countries (Tang & Zhang, 2019). This underscores the need for region-specific solutions that address the unique challenges faced by women in different parts of the world.

Despite some progress, particularly in Western Europe where diversity policies have led to tangible improvements, women from developing countries remain disproportionately underrepresented in the maritime sector. Patriarchal beliefs, which dominate many non-OECD countries, combined with limited access to affordable education and training, create significant barriers to entry for women (Gupta, 2021, Narayanan, Emad, & Fei, 2023). Therefore, addressing these issues requires both international and national-level interventions that are sensitive to the specific needs of women in different regions.

Table 1: Key barriers faced by female seafarers

Barrier	Description	Impact	References
Harassment and Safety Risks	Workplace harassment, isolation, and discrimination create unsafe conditions for women at sea.	Leads to underreporting, social withdrawal, and career abandonment.	Lyu & Li (2023); Carballo Pineiro & Kitada (2020); Anglo-Eastern (2022)
Wage Disparities	Women earn significantly less than male counterparts in the maritime sector. women earn just 50 to 60 pence for every pound earned by their male counterparts, underscoring persistent pay gap.	Creates economic inequality and discourages women from entering the industry.	Kormych (2020); Kelly (2018); Nix & Stiffler (2016)
Hegemonic Masculinity	Male-dominated culture reinforces patriarchal values and gendered language.	Limits inclusion and makes career progression difficult for women.	Connell & Messerschmidt (2005); Lyu & Li (2023)
Career Constraints Due to Family Responsibilities	Women face career stagnation due to family obligations and pregnancy concerns.	Reduces retention and advancement opportunities for women.	Lyu & Li (2023); Seedat-Khan et al. (2020)
The "Leaky Pipeline" Issue	Many women leave maritime careers before reaching senior positions due to gender bias.	Limits the number of female role models and leaders in the industry.	Lavissiere et al. (2019); Ruel & Jaegler (2021)
Company Policies & Workplace Conditions	Employers hesitate to hire women due to perceived operational costs and maternity leave concerns.	Reduces employment opportunities and workplace inclusivity.	Pike et al. (2017); Kim et al. (2019)
Physical & Psychological Health Challenges	Women face issues like fatigue, menstrual disorders, and inadequate healthcare on ships.	Affects job performance, safety, and long-term career sustainability.	Stannard et al. (2015); Lyu & Li (2023)
Intersectionality & Compounded Disadvantages	Gender, race, and nationality further marginalize women in maritime.	Creates additional structural barriers to employment and advancement.	Carballo Pineiro & Kitada (2020); Maritime UK (n.d.)
Educational Inequalities & Limited Training	Women in developing nations have restricted access to maritime education and training.	Limits career entry and skill development opportunities.	Pike et al. (2017); Tang & Zhang (2021)
Employment Inequality & Regional Disparities	Cultural norms in certain regions discourage women from maritime careers.	Restricts women's participation and career growth in specific regions.	Tangi (2016); Gupta (2021)
Globalization & Flags of Convenience	Cost-cutting measures in the shipping industry reduce opportunities for women.	Limits job stability and career prospects for female seafarers.	Guo (2019); Tang (2023)

2.8 Opportunities for Gender Inclusivity in Maritime through Automation

The shift toward automation and remote operations in the maritime industry presents an opportunity to address long-standing gender inequalities and create more inclusive workplaces. Traditionally, seafaring has been a physically demanding and hazardous profession, with women comprising only 3.23% of the global seafaring workforce as of 2019 (DoT, 2018). As the maritime sector shifts towards automation and Maritime 4.0 (Shahbakhsh, Emad, & Cahoon, 2022), manual roles are diminishing, creating new tasks while impacting workforce participation unevenly by gender, race, age, and socio-cultural factors (Narayanan, Emad, & Fei, 2023, Man et al., 2018). The advancements in technology, such as remote operating centers (ROCs) and Maritime Autonomous Systems (MAS), are poised to transform the industry by offering safer, more flexible working environments (Cai et al., 2023). These innovations could help underrepresented groups such as women and assist in offsetting most of the difficulties that have traditionally been contributing to limit the participation of women (DoT, 2019).

2.8.1 Enhanced Safety and Security in Remote Operations: One more positive feature of remote operations is the ability to mitigate many of the physical and psychological risks which the workers at sea faces. This includes loneliness, cramped living conditions and concern for safety. (Kim et al., 2019). These risks are especially pronounced for women because they are considerably exposed to risks of harassment and assault in traditional seafaring roles. Cai et al. (2023) focus on equity challenges for such vulnerable groups as women and minorities in remote maritime operations. In their study the seafarer female expressed that working in a remote operating center would afford her more security than would working in a cabin on a ship. This increased safety, along with clearer legal jurisdiction onshore, also benefits other marginalized groups TLGBTQIA+ groups, usually discriminated in countries where homosexuality is illegal. illegal (Cai et al., 2023).

2.8.2 Flexibility and Work-Life Balance for Women Seafarers: Another advantage of the remote operations, is flexibility, allowing the industry to be more accessible to women with family obligations. Traditional seafaring roles involve long periods away from family, a factor that has prevented many women from pursuing maritime careers (Carballo Pineiro & Kitada, 2020). A mother in her 40s, noted that while she had previously worked at sea, she now prefers remote work because it allows her to balance her professional and personal responsibilities: “I am a mom and I would never want to go to see [again], leaving my child behind” (Cai et al., 2023). This flexibility also sets an opportunity for people who left the sea because of family issues or some physical limitations, can go back as working crews in less demanding physical tasks (Kim et al., 2019, DoT, 2019).

2.8.3 Inclusivity for Workers with Disabilities: Remote operations offer new opportunities for people with physical disabilities, who have traditionally been excluded from seafaring roles. Customizable equipment in ROCs, such as adjustable chairs, screen mounts, and modified human-machine interaction interfaces, can accommodate workers with various physical needs, including those with hearing impairments or who use wheelchairs (Cai et al., 2023, Kim et al., 2019). However, despite these potential benefits, some participants expressed concerns about the inclusivity of current technological designs. Equipment and interfaces are often tailored to male users, with phrases like "men designing for men" frequently cited. For example, chairs and controls may not accommodate smaller body frames, and the lack of screen readers in languages other than English presents challenges for migrant workers (Cai et al., 2023, Tang, 2023). While technology has the potential to

improve inclusivity, organizational culture also plays a critical role in ensuring that remote operations support underrepresented groups. A male participant in his 40s, emphasized that simply hiring diverse employees is not enough; companies must foster a culture that aligns with inclusive values and supports career advancement for women and other marginalized groups (Cai et al., 2023). A shift in management strategies is essential to create environments where women feel valued and empowered to advance in their careers (Pike et al., 2017). Horck (2010) therefore suggested that Maritime education and training (MET) institutions should offer a mandatory course on cultural awareness and pedagogy that includes the gender perspective and emphasizes empathy. This will help to break down gender stereotypes and create a more inclusive and respectful learning environment for all students.

2.8.4 Career Progression and Opportunities in Remote Operations: Remote operations could also transform career progression in the maritime industry. Maritime careers remain stagnant, with limited prospect for promotion offered typically only others retire or quit the industry—called "dead man's shoes." (Cai et al., 2023). On the other hand, remote work, creates new opportunities for skill development and career mobility (Kim et al., 2019). Such a change could help in eradicating some of the structural impediments that have for a long-time hindered women's advancement in maritime careers (Rødseth & Nordahl, 2018).

2.9 Challenges in the Transition to Automation

Although there has been advancement in automation and remote operations, there are still barriers in their implementation. The increasing focus on IT specialization in remote control centers may inhibit changes towards gender equity because the IT sector like the maritime industry, remains predominantly male sector (Kim et al., 2019). The shift toward IT-intensive roles may exclude women unless efforts are made to encourage their participation in technical fields (Carey, 2017 Kretschmann et al., 2017).

Automation introduces new risks alongside its benefits. While autonomous systems are designed to reduce human error, improve efficiency, and lower operational costs (Kretschmann et al., 2017; Porathe et al., 2018), the absence of onboard staff could lead to reduced situational awareness during emergencies (Nganga et al., 2023, Wahlström et al., 2015). Additionally, cybersecurity threats pose significant challenges (Wróbel et al., 2017). Although automation can reduce some risks, such as collisions or groundings, other hazards—such as fires, explosions, and flooding remain (Kari et al., 2018). Therefore, the transition to greater autonomy in maritime operations must be carefully managed to ensure that new technologies enhance, rather than compromise, safety (Rødseth & Nordahl, 2018).

Despite these challenges, automation offers a unique opportunity to improve the quality of life for maritime workers, especially women. By shifting roles to shore-based remote operating centers, seafarers can avoid the long periods of isolation and physical demands traditionally associated with life at sea. These new positions, resembling office work rather than physically demanding tasks. This could make maritime careers more attractive to women and reduce the male dominance of seafaring roles (Rødseth & Nordahl, 2018). However, the industry must ensure that the shift toward IT skills does not exacerbate gender imbalances. Without integrating gender considerations into the development of MASS and RCC roles, technological advances may simply replicate existing inequalities in a new form. Achieving true inclusivity will require careful attention to the design of technology, recruitment strategies, and organizational culture (Cai et al., 2023). Thus, without deliberate effort

for inclusion, the risk remains that technological advancements can further deepen the existing gender inequalities (Wróbel et al., 2017; Kitada & Bhirugnath-Bhookhun, 2018).

2.9 Policy Initiatives for Gender Parity in Maritime

The integration of women into the maritime industry remains a significant issue. Numerous global initiatives aim to promote gender equality. The International Maritime Organization (IMO) and International Labor Organization (ILO) have implemented measures to address this issue. These efforts align with the United Nations' Sustainable Development Goal 5 (SDG 5), which focuses on achieving gender equality. However, gender inequality persists in seafaring roles. Progress towards integration of women in seafaring roles has been notably slow.

The Global Gender Gap Index (GGGI), introduced by the World Economic Forum in the year 2006, is useful framework for understanding gender disparities. The GGGI assesses gender equality across four aspects: economic participation, educational achievement, health, and political empowerment. The year 2023 GGGI report underscores ongoing obstacles for women. These include restricted job opportunities and substandard working conditions. Women also encounter difficulties in balancing work with caregiving duties due to insufficient support systems (WEF, 2023, García-Echalar et al., 2024). Research by Kim (2021) and Al-Nimri & Warrad (2020) further demonstrate these challenges. They reveal that gaps in education, skills, and labor participation impede women's entry into male-dominated fields including maritime, mining, and transportation.

The International Maritime Organization (IMO) launched the Integration of Women in the Maritime Sector (IWMS) program in 1988. This initiative unfolded in three phases: the institutional phase (1988–1996), the awareness phase (1997–2004), and the last phase, which focused on developing training programs and professional networks for women (Tansey, 2015, Kitada & Tansey, 2018). Despite these efforts, women still constitute a small portion of the maritime workforce. By 1998, women made up only 2% of seafarers, primarily in non-operational roles such as hotel and catering services. Even two decades later, women in operational roles—like deck officers and engineers—accounted for just 1% of seafarers. Many of these women were still in training and had yet to obtain their Certificate of Competence (BIMCO/ICS, 2021, Vo, Lavissière, & Lavissière, 2023, Carballo Piñeiro & Kitada, 2020).

In 2010, the IMO's STCW Manila Conference adopted Resolution 14, urging member states to ensure equal access to maritime training and increase women's participation in seafaring roles (Tang, 2023). At the national level, initiatives such as the UK's Women in Maritime Taskforce and Denmark's industry charter illustrate efforts to address gender disparities in specific countries (Bakhsh, 2020). Nevertheless, these initiatives have yet to significantly increase the number of women in seafaring roles, where they remain a minority, especially in cargo operations. For example, a workforce surveys by International Labour Office (2019) shows that women represent only 0.12% of deck officers and engineers in the seafaring population. The cruise industry presents a stark contrast, where women make up 28-30% of the workforce, but this higher representation is not reflected in cargo shipping.

In 2019, the IMO passed Resolution A.32/Res.1170, establishing May 18 as the "International Day for Women in Maritime". The year 2022 theme, "Training-Visibility-Recognition," aimed to create a more inclusive environment, promoting women's access to maritime careers. However, challenges remain, including a lack of female role models and the perception of the sector as unappealing or hostile to women (Lyu & Li, 2023). Despite the actions like the IMO's 2019 theme, "Empowering Women in the Maritime Community" and the Busan

Declaration (2013), progress remains slow in maritime toward gender parity and women still are not integrated in the operational roles (Narayanan, Emad, & Fei, 2023).

While international efforts by the IMO, UN, ILO and other organizations have laid a foundation for promoting gender equality in maritime, much work is still to be done. Legal, cultural, and institutional barriers continue to hinder women's advancement in the industry. Consequently, solving these problems requires coordinated global standards and further engagement from both public and private stakeholders to create a truly inclusive maritime workforce.

2.10 Conclusion

This literature review has explored the persistent gender inequalities in the maritime industry, revealing various obstacles hindering women's full participation. Despite numerous initiatives and policy changes, progress toward gender parity has been slow, with women remaining significantly underrepresented in seafaring roles. The review has illuminated a lack of comprehensive research on gender issues in maritime compared to other sectors like law and medicine, where progress toward equality has been more pronounced. This research deficit is a critical barrier to understanding the complexities of gender disparities in maritime and developing effective solutions.

More research should be conducted on gender equality as gender diversity has been noted to enhance organizational performance in many fields (Tang, 2023). Firms with greater female professionals have higher financial returns (Owen& Temesvary, 2018). Their participation corelates to the improved corporate social responsibility (Byron & Post, 2016). As noted by Sastre (2014) diverse teams achieve more in innovation-driven sectors. These observations can be applied to the maritime industry.

Understanding gender balance can contribute to both industry growth and alignment with global goals like the UN SDGs. Ongoing technological advancements, such as automation and remote working, are transforming the maritime industry. Ensuring gender inclusivity is crucial in this context. The automation of repetitive tasks minimizes the physical constraints; nevertheless, it amplifies the call for human creativity and adaptability (Leveson, 2011). There should be more research on how to train and sustain gender diversity in these evolving roles (Tang & Gekara, 2020).

Despite the recognized benefits of diversity, the maritime industry lacks gender-specific data. This gap limits insights into gender inequalities (Nduna & Sys, 2020). Additional research is needed to fill these gaps especially on issues affecting working women, changes in qualification standards for autonomous roles, and legal aspects of technologies. Such research can foster innovation and enhance value creation and delivery (Bilan et al., 2020). Possible future research directions include how much gender inequality means in terms of talent, productivity, and creativity loss. Expanding the scope of research to address this data deficit is crucial for creating a truly inclusive and equitable maritime workforce.

The industry's focus on environmental and ethical challenges, such as emissions and human rights abuses, often overshadows the importance of gender equality. Yet, gender equity is vital for improving both ethical standards and innovation (Bilan et al., 2020; Hoffmann & Coate, 2022). Incorporating gender diversity into sustainable management plans could drive broader positive changes. These would address both ethical and performance-related outcomes. What makes the problem look even more galling is that discrimination remains rife even in organizations where female candidates form the majority of the workforce. This shows that proportional representation alone does not necessarily eliminate prejudice. A study by Glick and Fiske (1996) highlights how sexism and gender biases are harmful to the workplace dynamics. It concerns with the ‘inequality

regime' which Acker (2006) associated with race and class. Addressing these entrenched biases is essential for achieving genuine diversity and equality in the maritime industry.

Even when trying to encourage more women to join the maritime sector, gender stereotypes still dominate the industry. These stereotypes mirror those seen in fields like mathematics (Spencer et al., 1999). Societal views on gender differences continue to affect workplace dynamics (McCarthy & Moon, 2018). To address these issues, rethinking social and organizational structures is required that embed bias (Phillips and Knowles 2012). Thus, it is concluded that structural change is key to the achievement of a more inclusive maritime workforce.

The problem of gender diversity in the maritime industry has been explored to a lesser extent compared to other sustainability fields. Although Harvey et al. (2022) suggested a gender gap index to address unemployment and occupational segregation, a thorough analysis of global gender disparities in maritime is still needed. Gender issues are becoming more prominent. This should be seen as an opportunity for policymakers to improve conditions for minority seafarers. Maritime is usually not easily visible to the public domain most of its activities take place offshore and public access to ports is also limited (Tang, 2012; Pike et al., 2017), The concept of seafaring as a masculine profession also discourages women from joining the maritime sector. More studies must also be conducted to develop awareness campaigns, education, and role models. These efforts can challenge these perceptions, showing that seafaring is not exclusively male and promoting gender equity in the industry.

The literature analysis indicates that there is a gap in the literature on extensive research on how the technological developments affect women employment in the dynamic maritime industry. As automation shifts the industry's demands towards cognitive and social skills rather than physical strength, it can level opportunities across gender, race, and age (Narayanan, Emad, & Fei, 2023). Further research is needed to explore how these changes can promote gender equality and inclusivity in maritime employment.

3. Methodology

3.1 Introduction

This study adopted a mixed-methods research design, integrating both quantitative and qualitative data to gain a comprehensive understanding of the factors affecting women's participation in the seafaring profession in the context of ongoing digitalization and automation onboard ships. The mixed-methods approach enabled the exploration of both the measurable prevalence of specific barriers and the nuanced perceptions and experiences of women in the field. The study is exploratory and descriptive in nature, aiming to capture individual perceptions, organizational practices, and industry dynamics. This design is particularly appropriate for understanding complex socio-cultural issues within the maritime industry (Makri and Neely, 2021).

In the first stage, we conducted an in-depth literature review and analysis of available research outcomes in the field of women in seafaring, maritime human resources, shipping 4.0, digitalization and automation in maritime domain to formulate the understanding of the role and position of women seafarers in the shipping and the current and future direction of technology implementation in the shipping industry. The aim was to develop the necessary knowledge and build upon the latest research in the field. In the second stage of the study, we collected primary data from our targeted groups.

3.2 Sample and Sampling Technique

This study engaged a total of 108 participants drawn across the international maritime community. The sample was composed of individuals representing three distinct clusters-

a) ***Active Seafarers-*** including cadets, deck and engine officers, and other shipboard personnel currently engaged in seafaring professions.
b) ***Shore-Based Maritime Professionals-*** such as shore-based personnel working in shipping companies, compliance officers, and port authority staffs.
c) ***Other Maritime Stakeholders-*** comprising academicians and researchers, technology providers, representatives of organizations focused on gender equity in maritime (e.g., WISTA), policymakers as well as national and international maritime agencies.

A *purposive sampling strategy* is adopted to ensure a diverse and informed set of respondents who can provide rich insights on the gender dynamics of the shipping industry. This strategy was complemented by elements of *snowball sampling*, particularly in reaching specialized respondents within advocacy groups and maritime education institutions.

The primary data collection tool, a structured Qualtrics-based questionnaire, was disseminated online over a two-month period (March and April 2025). The survey link was shared via targeted email invitations, professional networks, and social media platforms such as LinkedIn, enabling wide geographic and professional outreach. This distribution strategy was designed to maximize reach while maintaining a focus on relevance and respondent expertise. In addition to the questionnaire, 15 semi-structured interviews were conducted in person with key informants from the above groups. These interviews helped to deepen the insights gathered from the survey responses (Jain, 2021), offering contextual richness and elaboration on key thematic areas such as organizational culture, policy effectiveness, and technology's role in promoting gender inclusion.

While 108 survey responses were collected, not all respondents completed every question, leading to some variation in the response rate across individual survey items. Partial responses were retained for analysis to preserve the breadth of perspectives offered.

3.3 Data Collection Tools and Procedure

The primary tool for data collection was a structured questionnaire developed in Qualtrics. The questionnaire consisted of 25 questions, most of which had two-parts:

a) ***Part 1:*** Closed-ended questions offering multiple-choice or Likert-scale options to generate quantifiable data.

a) ***Part 2:*** Open-ended text boxes that allowed participants to elaborate on their choices or share personal experiences and perspectives.

This design facilitated both statistical analysis and in-depth thematic exploration. Additionally, a limited number of follow-up interviews (15) were conducted with select stakeholders to validate and enrich the findings from the survey data.

The survey was disseminated online via direct email invitations, professional networks and maritime organizations. The data collection period extended over eight weeks to accommodate the schedules of seafaring and shore-based personnel. All responses were anonymized to maintain confidentiality and encourage honesty in sensitive areas such as harassment, pay disparities and organizational culture.

3.4 Data Analysis

Quantitative data from closed-ended questions have been analyzed using descriptive statistics, including frequency distributions and percentages, to identify dominant trends and patterns across the respondent categories. Qualitative data from open-ended responses and interviews have been analyzed to support or oppose the findings of the quantitative results. Data triangulation between quantitative results and qualitative narratives strengthens the reliability of the findings and allowed for more nuanced interpretations (Jain, 2021; Makri and Neely, 2021).

3.5 Ethical Considerations

The research was conducted in accordance with academic ethical standards which has been approved by the University of Tasmania Human Research Ethics Committee (HREC) (ID 31053). Participants were informed of the purpose of the study and provided informed consent before participating. All responses were kept confidential and were analyzed in aggregate form to ensure anonymity. The use of open-ended questions allowed participants to skip sensitive items if they preferred not to respond, which was respected throughout the analysis.

4. Analysis and Discussion

4.1 Introduction

This chapter presents a detailed analysis of collected qualitative and quantitative data on women's participation in the maritime industry with the focus on the impact of technology. The findings are structured into four main sections:

a) demographic profile of respondents,

b) factors affecting women's participation in seafaring,

c) impact of technology on women's participation in a digitalized maritime future, and

d) pathways to gender equity in maritime industry.

Data were collected from the total of 108 women in actively employed in different sector of the maritime industries. The findings not only highlight key trends and statistics but also the qualitative insights from the female maritime workforce.

4.2 Demographic Profile of the Respondents

4.2.1 Roles in the Maritime Industry: In total 73 of research participants disclosed their present roles and professional details. Based on their responses, we categorize them in three groups- a) active seafarers, b) shored-based maritime professionals, and c) other maritime stakeholders. We have received proportionate participation of respondents under each group as shown in ***Figure 1***. The most significant segment (n=27, 37%) is active seafarers, followed by shore-based maritime professionals (n=24, 33%) while other maritime professionals (n=22, 30%) included academician, technology providers, policymakers, and other maritime related professionals.

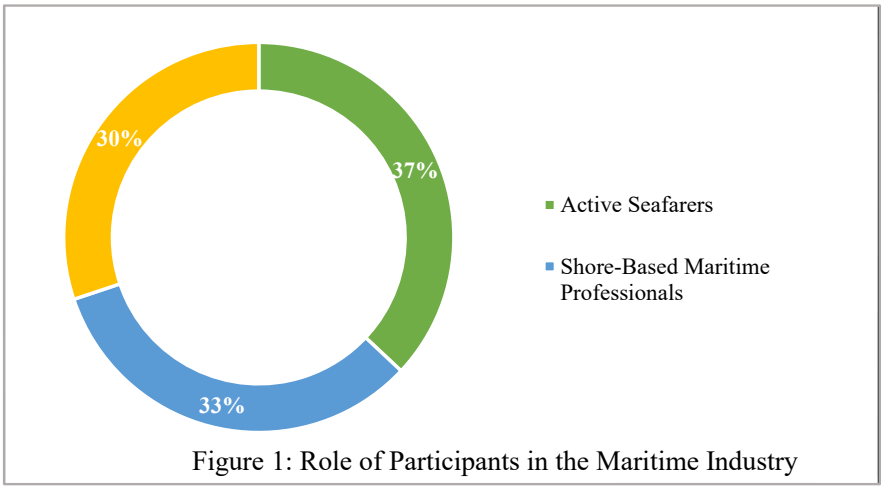


Figure 1: Role of Participants in the Maritime Industry

4.2.2 Years of Experience: Respondents spanned a wide range of professional experience from less than 1 year to more than 20 years. This rich variation strengthens the robustness of the dataset, bringing perspectives from both emerging and seasoned professionals.

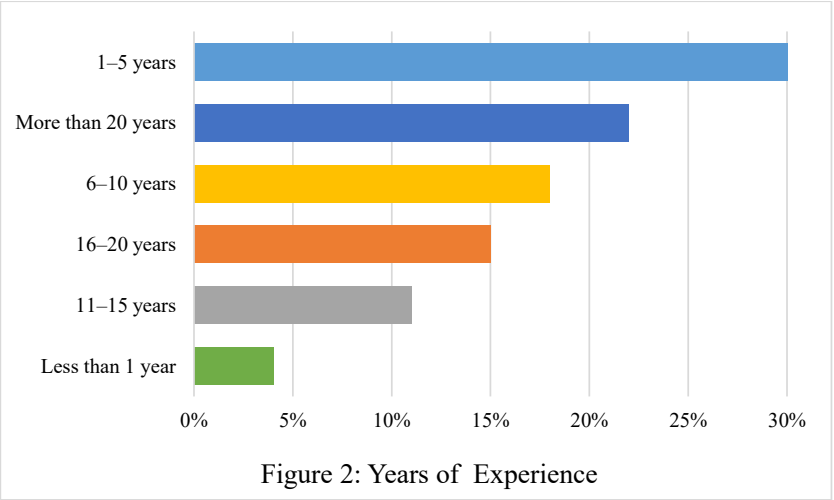


Figure 2: Years of Experience

4.3 Factors affecting women's participation in seafaring

The primary aim of this study is to investigate the factors impacting women's participation in seafaring in a highly digitalized shipping industry. Our extensive literature review reveals several significant barriers affecting women's participation. To conduct extensive investigation, we asked our research participants to mention the factors affecting women's participation in seafaring. Quantitative data from the bar diagram (***Figure 3.1***) indicates that a male-dominated culture in the industry is perceived as the most substantial impediment (n=46). This is closely followed by concerns regarding harassment and safety risks (n=35) and difficulties related to work-family conflict (n=31). Other notable barriers identified through multiple-choice responses include physical and psychological health challenges (n=21), wage disparities (n=20), and the absence of mentorship (n=20).

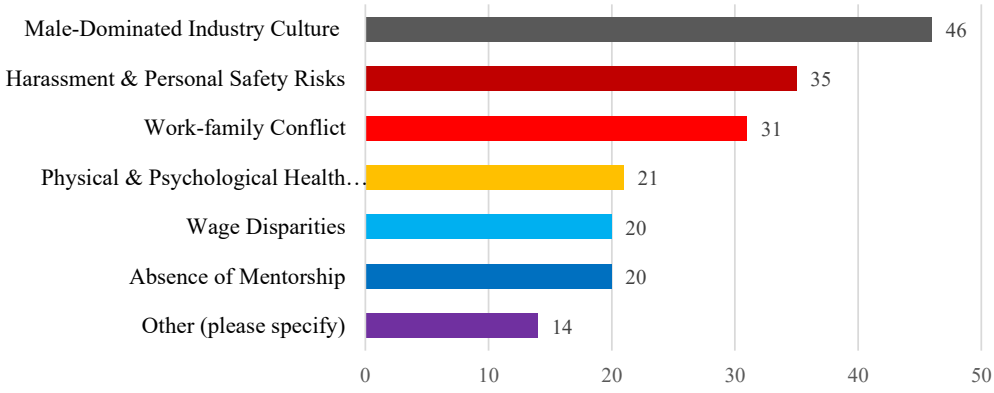


Figure 8: Factors affecting women's participation in seafarering

These findings are further corroborated and expanded upon by the qualitative data visualization in the word cloud. The prominence of terms such as ***"cultural," "gender," "discrimination," "stereotype,"*** and ***"bias"*** underscores the deep-rooted nature of the male-dominated environment and its associated exclusionary practices. The centrally featured word ***"opportunity,"*** appearing in conjunction with terms like ***"limited," "lack," and***

"challenge," suggests that the perceived scarcity of equitable opportunities for entry, advancement and fair treatment is a critical concern. Furthermore, the recurrence of "family" in the word cloud aligns with the "work-family conflict" identified in the respondents' quantitative data.

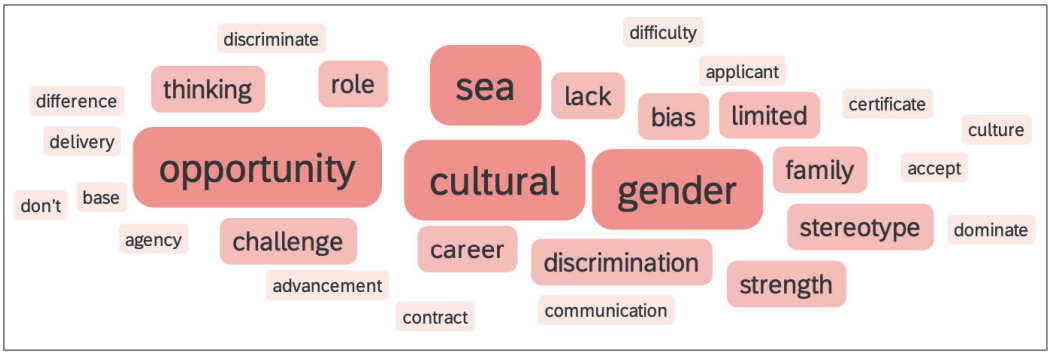
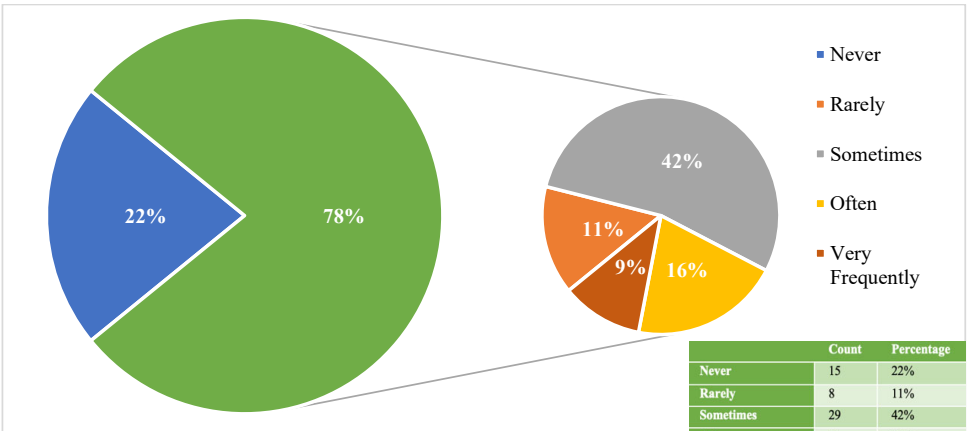


Figure 3.2: Factors affecting women's participation in seafaring

4.3.1 Male-Dominated Industry Culture: The study identifies male-dominated culture in the industry as the most significant barrier to women's participation in seafaring (Figure 3.1). For further investigation into this factor, we asked three follow-up questions related to this issue.

Fist follow-up question was related to their experience of any gender specific challenges in their career. Around 80% respondents have encountered gender-specific challenges in their careers. While "Sometimes" was the most common response (n=29, 42%) to facing such challenges, a notable portion reported "Often" (n=11, 16%) or "Very Frequently" (n=6, 9%). However, a significant number of respondents reported that they have "Never" (n=15, 22%) experienced any gender specific challenges in their career.



	Count	Percentage
Never	15	22%
Rarely	8	11%
Sometimes	29	42%
Often	11	16%
Very Frequently	6	9%

Figure 4: Experience of gender specific challenge

Qualitative feedback further elucidated these challenges, including experiences of doubt from others, pressure to constantly prove oneself, the feeling of being outnumbered, traditional stereotypes concerning female capabilities and work recognition, and specific obstacles for women in management and commercial roles. For example, one of respondent mentioned, ***"Working in a male-dominated industry I also have shared obstacles…".***

Another participant stated, ***"Yes, sometimes, doubt from others, the pressure to prove myself, and the feeling of being outnumbered. Traditional stereotypes on females and work recognition."*** The above data and qualitative feedback clearly indicate that the prevailing industry culture is a major barrier to women's participation in seafaring profession.

The second follow-up question was regarding the effectiveness of current gender equality initiatives in the maritime sector. The most common view among of the respondents is that they are "Moderately effective" (n=44, 72%). While 21% respondents (13) considered them "Highly effective," and 8% participants (5) found them "Not effective at all".

Qualitative data suggest that while initiatives are seen as a ***"step in the right direction,"*** there is "***still a long way to go***" before true equality is achieved, where skills matter more than gender. Some positive developments, such as an increasing number of women in leadership, were acknowledged. However, there is also a perspective that initiatives may not be fully addressing the core issue, with one respondent suggesting the focus should be on ***"the perception and courage of female individuals"*** to enter and adapt to a male-dominated profession rather than expecting the sector to fundamentally change for them.

The third follow up question was on the required measures for improvement. Respondents proposed several measures to improve gender equality and address the male-dominated culture. The most frequently cited measures were equal pay (n=40), improved access to education and training (n=36), flexible working arrangements (n=35), shifts in cultural norms (n=35), need for mentorship programs (n=34), strict policies against discrimination (n=32), favorable national and international policies (n=30).

Qualitative suggestions further emphasized the need for ***"Equal opportunity, better representation and a cultural shift where respect and skill matter more than gender"***. Other recommendations included fostering leadership and a supportive work environment, implementing training and development programs, and ensuring women's inclusion in all activities, particularly in leadership position.

> ***"Some of the measures that might improve gender equality are leadership, support work environment and training programs and development programs."***
>
> ***"Expand the implementation of laws that are appropriate for women in the maritime industry."***
>
> ***"Focus on promoting equal opportunities, implementing gender-sensitive training, and ensuring anti-discrimination policies and approaches, while also fostering a culture of inclusion and support for women."***
>
> ***"To encourage everyone to voice out their opinions regarding harassment or discrimination if there is. Also, to conduct seminars/trainings as an avenue to spread gender equality awareness in the maritime industry."***

In summary, the findings depict a maritime industry where a male-dominated culture significantly impedes women's participation. This is characterized by frequent gender-specific challenges and a perception that current equality initiatives, while acknowledged as steps forward, are only moderately effective. Respondents advocate for multifaceted interventions focusing on equal pay, improved access and opportunities, flexible work, cultural shifts, mentorship, and stricter anti-discrimination policies to foster a more inclusive and equitable environment.

4.2.2 Harassment and Safety Risks: The findings underscore that harassment and safety risks remain a significant barrier to women's participation in seafaring professions. Approximately 40% of respondents reported having either experienced or witnessed harassment or discrimination at sea, while around 60% respondents reported no such incidents. These findings reflect a troubling degree of exposure to unsafe behavior in what should be professional and safe maritime environments.

The descriptive statistics for the selected choice related to the handling of these situations (where 1 = Not at all and 7 = Extremely well handled) reveal a mean score of 5, with a minimum of 4 and a maximum of 6. This suggests a generally neutral to slightly positive perception of how such incidents is handled, although the limited range of responses warrants cautious interpretation.

Table-1:Descriptive statistics on harassment and discrimination at sea

No	**61%**	**36**	**4**	**4**	**4**
Yes	39%	23	6	6	6

The qualitative responses provide crucial context to these figures. Several narratives highlight instances where women seafarers were not taken seriously, suggesting a potential gender bias in interpersonal interactions at sea. For example, a respondent stated,

> ***"Fortunately, I haven't faced it directly, but I've seen moments where women weren't taken as seriously, some speak up, some stay silent. How it's handled depends on the leadership; good officers shut it down, but there's still a long way to go."***

This indicates that while some incidents may be addressed effectively by proactive leadership, a culture of potential bias and instances of inaction may persist. Another respondent offered a more assertive approach, stating, ***"Yes. Harassment/discrimination will stop if the victim will fight back,"*** implying that effective resolution may depend on the victim's agency rather than solely on institutional mechanisms. Furthermore, a respondent advised, ***"First tell your supervisor or manager about what you see and what you hear, because you are the voice and eyes of that person to tell the truth,"*** highlighting the importance of reporting mechanisms, though the effectiveness of these mechanisms is not consistently reflected in the quantitative data. Finally, one response broadened the scope to include nationality, stating*; "**Yes, for us as a citizenship development requirement, we encounter such acts on board by my co-workers (both male & female), but we initiate to help those old women and reflect to the human resources."***

This suggests that harassment and discrimination can manifest across various dimensions, including gender and potentially nationality, and that proactive intervention by colleagues can play a role in addressing these issues.

The risks associated with harassment do not exist in isolation. They are closely linked to broader ***challenges of physical*** *and* ***psychological health*** experienced by women at sea. As indicated in our findings, physical and psychological health challenges is also a frequently cited barrier to women's participation in seafaring. The experience of harassment or discrimination, whether direct or observed, can lead to chronic stress, anxiety, depression, and even trauma which may compromise performance, well-being, and retention.

Moreover, unsafe environments contribute to a persistent sense of vulnerability and isolation, particularly on long voyages or in male-dominated environment, exacerbating existing physical and mental stressors. As a result, harassment not only endangers immediate safety but also contributes to the deterioration of long-term

mental and physical health. Thus, it reinforces a cycle that deters women from entering or remaining in seafaring professions. These interrelated challenges highlight the urgent need for comprehensive interventions that address both the cultural and organizational dimensions of workplace safety and provide robust mental health support systems tailored to the realities of life at sea.

Although a significant portion of the respondents reported not experiencing or witnessing harassment or discrimination, the experiences of the remaining seafarers, as highlighted in the qualitative data, point to the existence of gender bias and the potential for mishandling or inconsistent addressing of such incidents. The mean score regarding the handling of these situations suggests a moderate level of satisfaction but the nuances in the qualitative data indicate that the effectiveness of resolution can vary and may depend on factors such as leadership intervention and the assertiveness of the affected individuals or witnesses. These findings underscore the need for continued vigilance and the implementation of robust and consistently applied policies and training to ensure a respectful and equitable working environment for all seafarers. Technology enables women and the regulatory bodies to implement such a robust and consistent harassment handling framework.

4.3.3 Work-family conflict: Work-family conflict has been found in this research to be the third most significant factor negatively impacting the seafaring career for women. Our literature review also suggests that women seafarers suffer from career constrains due to traditional family responsibility. As a result, we investigated this issue by follow-up questions to participants.

The first follow-up question explores the impact of family responsibilities on career progression in the maritime industry. The results indicate that family responsibilities pose a significant challenge to career advancement for women. Quantitatively, a large portion of the respondents (more than a third) reported a "Significant impact," where a small group (12.5%) reported an "Extreme impact". The mean impact was 5 on a scale of 7, demonstrating the considerable degree to which family obligations impede professional growth in the maritime domain. Qualitatively, participants also confirmed the difficulty of reconciling long periods at sea with family duties, the influence of societal expectations that often place a disproportionate burden of caregiving on women. Additionally, the prioritization of family events like childbirth and childcare, creates conflict with career demands. They expressed their concerns noting that "***Long months at sea make balancing family and career tough, especially for women"***. Societal expectations also play a role, as women often feel pressured to be the primary caregivers: ***"Perception and expectation of the society, especially for women who are expected to take care of the family and children".*** Family events, such as ***"giving birth or taking care of children,"*** are seen as competing priorities with a seafaring career.

Table 2: Impact of family responsibility on career progression of women seafarers

Impact of family responsibility	Percentage	Count	Average	Minimum	Maximum
Slight impact	29%	16	4	4	4
Moderate impact	23%	13	5	5	5
Significant impact	36%	20	6	6	6
Extreme impact	13%	7	7	7	7

The second follow-up question investigated the difficulty of balancing work and personal life in the maritime industry. The findings reveal that achieving this balance is a substantial struggle for many women. The

IAMU International Association of Maritime Universities (AMC)

quantitative data shows that a substantial number (more than 70%) of respondents found it moderate to extremely difficult to balance their work with their personal lives. Although only 5% of them reported as "Extremely difficult". The mean difficulty rating was 5 out of 7, highlighting the considerable challenge women face in harmonizing their professional and personal spheres. The qualitative responses to this question emphasized the importance of time management as a key strategy for navigating this balance, with respondents stressing the need for effective scheduling and self-care to manage the demands of maritime work.

Table 3: The difficulty of balancing work and personal life

	Percentage	Count	Mean	Standard Deviation	Min	Max
Slightly difficult	30%	16	5	1	4	7
Moderately difficult	37%	20				
Very difficult	28%	15				
Extremely difficult	5%	3				

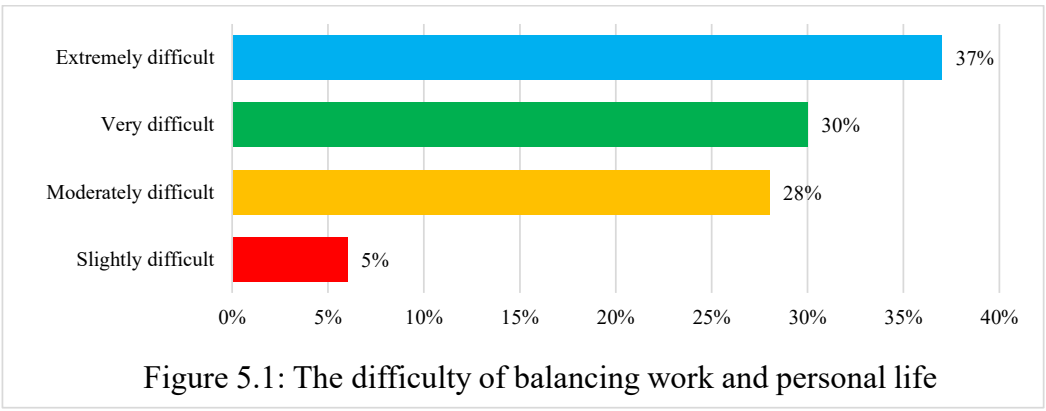


Figure 5.1: The difficulty of balancing work and personal life

The third follow-up question explored how women balance their work and personal lives in the maritime industry. When asked, the research participants emphasized the importance of time management. They suggested that it needs to be done ***"through time management"*** and by creating ***"an effective time management schedule that supports self-care and flexibility".*** On the other hand some participants mentioned that ***"I enjoy work and at the same time taking care of personal needs"*** by focusing on health by trying to ***"make sure I have enough sleep and eat good foods".***

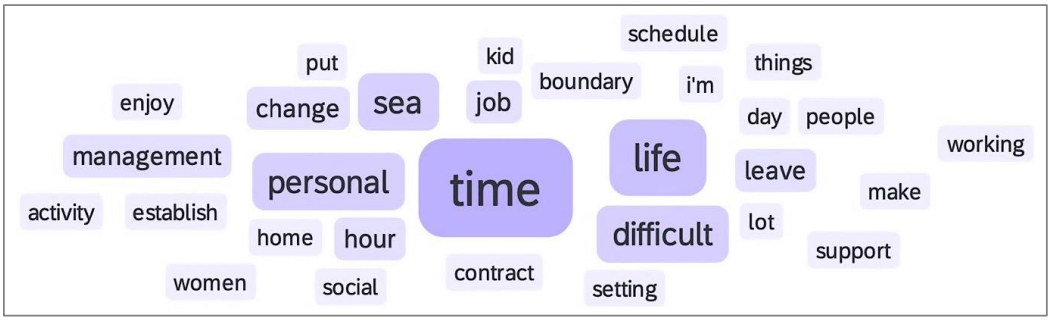


Figure 5.2: Suggestions for balancing work and personal life

The analysis of the three follow-up questions demonstrates that work-family conflict is a critical factor affecting women's participation in seafaring. The data highlights the strain between family responsibilities and career progression, the difficulty of balancing work and personal life, and the coping strategies employed by women in this demanding profession. The combination of quantitative data, illustrating the extent of the challenges, and qualitative data, providing context and personal experiences, creates a comprehensive picture of the impact of work-family conflict.

4.3.4 Absence of role models and mentorship: Only one respondent believes that there is a significant female representation while the majority (more than two third) of the participants reported few or very few role models available in the industry. The lack of visible leadership among women continues to discourage aspirants. However, there were a much smaller cohort of research participants (n=12) had different experience regarding availability of female role models in the maritime industry, indicating possible gradual shift in women leader's representation in the maritime industry.

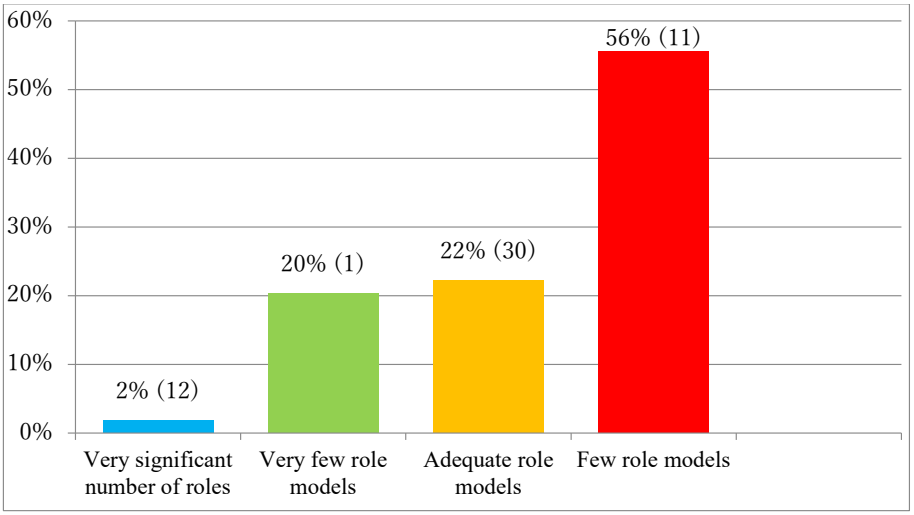


Figure 6: Women representation in the maritime industry

This issue is also reflected in the qualitative data which stress the importance of representation in the leadership team to inspire future professionals and a gradual shift in the situation. For instance, the following comments of the respondents (from cluster-1: Active seafarers) clearly indicates lack of representation but a gradual improvement-

> ***"It's still tough, but every woman who steps on board makes it easier for the next. I see resilience, progress and a future where we no longer see exceptions for engineers."***
>
> ***"It is getting better, and the situation is continuously improving."***
>
> ***"Not much but challenging"***

4.3.5 Organizational support and equal opportunities: Organizational support plays a crucial role in gender equality. Our data analysis found that organizational support and providing equal opportunities as one of the significant factors affecting women's participation in the maritime industry. Our data shows that equal and equitable training, wage, and career opportunities promotes diversity and inclusion. Supporting diversity,

inclusion, and ensuring equal opportunities at organizational level thus carries paramount importance for women's participation. To empirically investigate this issue, we asked about their experience with organizational support. Both quantitative and qualitative data indicates that women seafarers avail adequate organizational support. Almost two third of the respondents mentioned that to a large or very large extent organizational support can help retention of women seafarers in the industry. However, only about 16% of respondents rated organizational support to have a minimal or no effect. Qualitative inputs praised initiatives such as female-led leadership workshops and gender-inclusive hiring, but some also highlighted tokenistic practices.

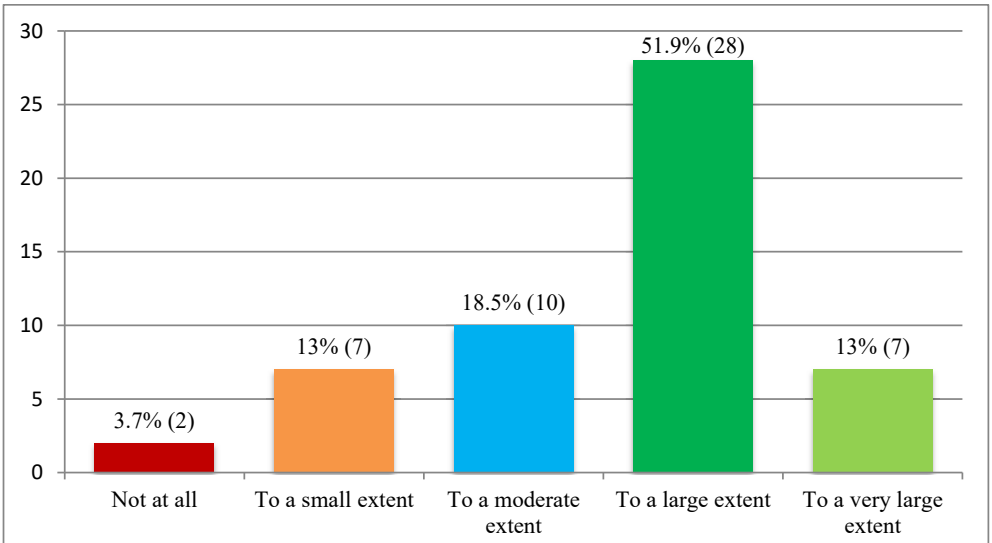


Figure 7: Organizational support for gender deversity and inclussion

To investigate this issue further, we asked two follow-up questions related to training and development opportunities in their organizations, and wage disparity. While most of the respondents affirmed that their organizations support gender diversity and inclusion, the analysis of the follow-up question on specific training and development opportunities revealed a more precise picture. A quarter of research participants mentioned that the most commonly available programs included leadership training (n=26), technical skills development (n=25), and upskilling or reskilling (n=24). However, only 12 respondents reported that there are mentorship programs in their organization. This is despite the fact that mentorship is a known to be a catalyst for retention and advancement in career. This indicates a critical gap in structured career guidance for women. Moreover, all these training and development program are designed for both men and women, highlighting the lack of gender specific training and development initiatives. One of the respondents highlighted this issue by saying; ***"We all have training, not only for women. They give us training especially for developing oneself and improving."***

Noting the shipping is an international career and most the international shipping is run by multinational crew, there were only few responses mentioned language training. This may reflect the limited organizational focus on broader professional communication development. Encouragingly, 20 respondents acknowledged access to anti-harassment training, a crucial safeguard for inclusive work environments. Qualitative responses suggested that while many organizations claim offering equitable training, the depth and gender-specific targeting of these

initiatives are wide spread in some organizations. For instance, one of the participants noted*; **"Leadership programs, workshops, and seminars are headed by female personnel and advocate for gender equality."***
The statement points to a positive change in some institutions. Yet the uneven availability of core development tools, especially mentorship, underscores the need for more strategic and comprehensive organizational support systems that actively promote women's long-term inclusion and leadership in the maritime careers.

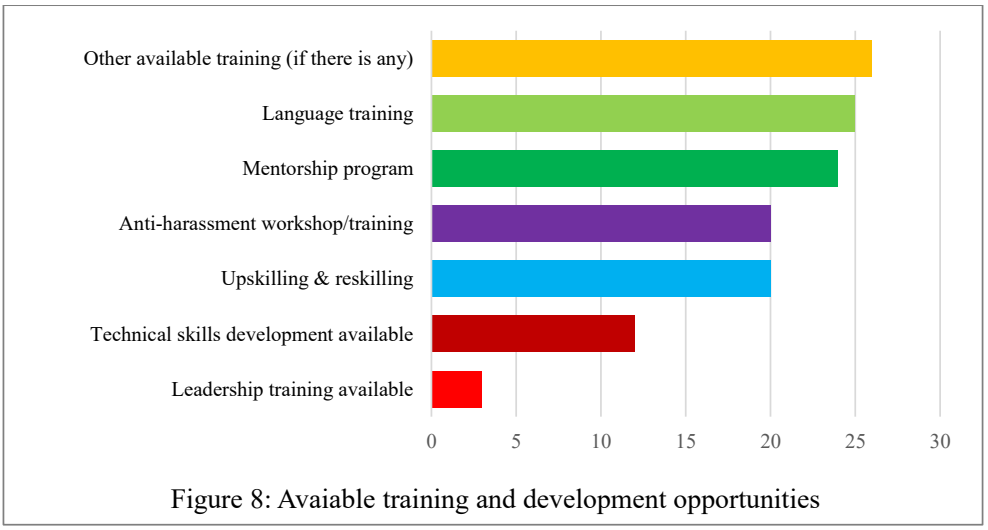


Figure 8: Avaiable training and development opportunities

The second qualitative follow-up question on wage disparities reveals several key themes. While "wage disparity" was initially identified as a major barrier to women's participation in seafaring by some of the respondents, the deeper insights suggest a different perspective. A significant number of respondents believe that wage disparity is not prevalent in the maritime sector. For instance, statements like- ***"I don't think there are wage disparities between men and women," "We have equal salary," and "It is already the same with gender"*** reflect a perception that compensation is already equitable. Moreover, some emphasized that wages are determined by rank rather than gender***; "Seafarer salary is based on the position, not on gender, so there is no bias," and "Same rank–same wages."***

However, a few respondents advocated for proactive measures to ensure transparency and fairness, suggesting *a transparency in the payment system.* For example, a respondent mentioned ***"Implementation of gender equal pay policy and reporting system can bring a big difference,"*** *and other mentioned* ***"It needs to be ok to share your salary with others so that you know that you're being treated fairly."***

These comments highlight that while wage structures may appear gender-neutral in policy, the perceptions or experiences of disparity still linger for some. Additionally, responses such as ***"Establish fair compensation policies regardless the gender and a standardized pay structure," and "Must be equal wage depending on position,"*** emphasize the importance of institutional mechanisms to uphold a transparent equity policy. Interestingly, one respondent linked the issue to broader gender equity initiatives, recommending to ***"Promote women in leadership roles through mentoring programs," and "Provide leadership training for women,"*** pointing toward systemic policy change beyond just pay equity. Overall, while wage disparity may not be universally experienced, the findings suggest a need for continued attention to transparency, policy enforcement, and broader cultural transformation in the maritime sector.

Based on the above findings, it can be concluded that there are four specific areas where interventions are required to improve women's participation in seafaring professions. These areas are-

a) Cultural intervention in the male dominated industry: The intervention needs to be in the form of policy reform and advocacy for equal pay, improved access and opportunities, flexible work, cultural training, and stricter anti-discrimination policies to foster a more inclusive and equitable environment.

b) Managing harassment as well as physical and psychological health: Although our data shows that harassment or discrimination is not as prevalent as it used to be however, some seafarers, point to the existence of gender bias and occasional mishandling or inconsistent addressing of such incidents. These findings underscore the need for implementation of robust policies and training of the workforce to ensure a respectful and equitable work environment for all seafarers.

c) Addressing the work-family responsibilities conflicts: As discussed, women seafarers are facing career constrains due to the traditional role of women in family and their responsibilities. Apart from cultural advocacy there is a need for organizations to take into account these constrains on women in the industry and have strategies in place to mitigate these discriminations.

d) Absence of women role models and mentorship program: Participants pointed out the importance of mentorship and presence of role models in the industry. There is a need for policies to support promotion of women seafarers and giving the leadership opportunities to them can help to retain the current workforce and attract the next generation to the industry.

In this research we investigated how technological advancement and related policy interventions can mitigate these issues and ease the inclusion and career development of women's seafarers.

4.4 The impact of technology on women's participation in a digitalized maritime future

The primary objective of this study is to explore the factors impacting women's participation in seafaring in the shipping industry and to investigate the impact of the ongoing digitalization and automation on women's participation in the maritime sector. Our findings in previous section (4.3) reveals that there are four specific areas or issues that require technological innovation and policy intervention to promote women's participation in seafaring professions. To explore the impact of technological development on women's participation, we asked our research participants to give their views on the effectiveness of technology in promoting gender equality in maritime careers. We collected data both in quantitative and qualitative forms. The results of the quantitative part is shown below in ***Figure 9 and in Table 4.***

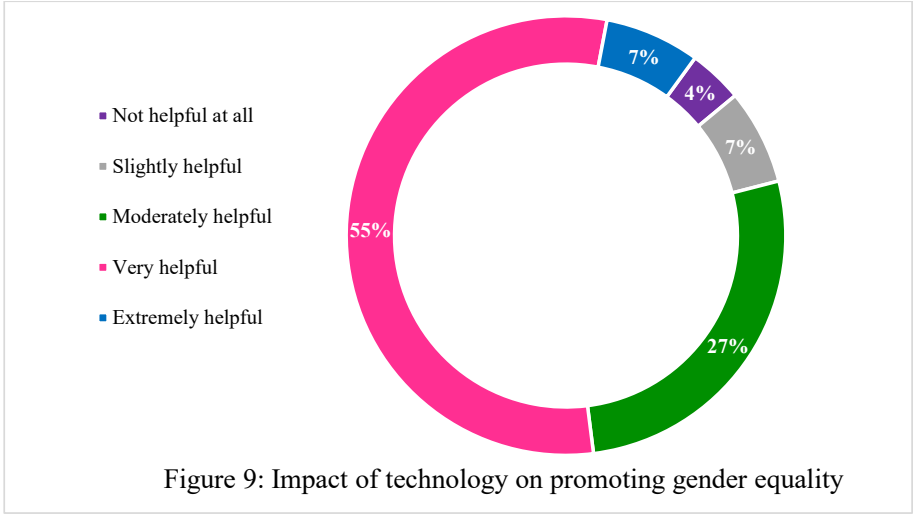


Figure 9: Impact of technology on promoting gender equality

Table 4: Impact of technology on promoting gender equality

Level of impact	Percentage	Count	Mean	Standard Deviation	Minimum	Maximum
Not helpful at all	4%	2				
Slightly helpful	7%	4				
Moderately helpful	27%	15	8	1	4	10
Very helpful	55%	31				
Extremely helpful	7%	4				

Analysis of the data indicates a strong perception among respondents that technology can significantly contribute to promoting gender equality in maritime careers. The quantitative data shows that a large majority of the respondents believe that the technology is helpful. There were only small cohort of research participants (4%) indicated that it may not be as helpful. This suggests a widespread optimism about the potential of technology to address the existing challenges.

The qualitative responses further elaborate on how technology can positively impact women's participation. A key theme is the leveling of the playing field by reducing the reliance on physical strength due to automation, digitalization, and smarter systems. As for example, a respondent stated-

> ***"Technology levels the playing field, especially automation, digital tools and smarter ships make skill matter more than strength. Opening more doors for women in maritime."***

Another significant aspect that highlighted is the potential for technology to improve communication, create support networks, and provide access to online learning and information. Respondents mentioned that technology can ***"Connect women in the maritime industry with mentors" improve their "networks" and allow for ease of "professional communications"***. The digitalization and advanced technology can provide ***"More online courses & tutorials, develop apps and show (share) in social media that can easily access info".***

Furthermore, technology is seen as a tool for raising awareness about female seafarers and promoting gender equality on a larger scale and at a faster pace. It can help in ***"spreading awareness in gender equality"*** and giving ***"an awareness about what is happening to the female seafarers around the world".*** The possibility

of remote and flexible work opportunities, such as remote vessel operation, is also seen as a benefit that technology can provide, making maritime careers more accessible and manageable for women. However, one respondent cautioned that technology alone is not a panacea, and its impact depend on its implementation alongside other initiatives like policy changes and leadership commitment. She mentioned that it may help but cannot fix the deeply ingrained cultural or structural barriers on its own. To further investigate this issue, we utilized a word-cloud highlighting 40 most significant words from the qualitative responses, as shown in ***Figure 10***.

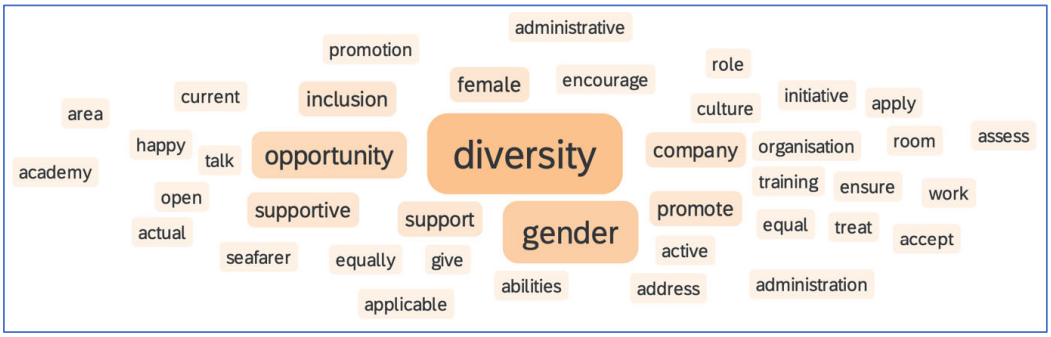


Figure 10: Word-cloud on the impact of technology on promoting gender equality

Analyzing the word cloud further underscores the key themes identified in the text analysis regarding technology's impact on women in maritime careers. The most prominent words, such as "diversity," "gender," and "opportunity," highlight the central focus of the respondents on achieving a more inclusive and equitable future workforce. Words like "support," "promote," and "inclusion" directly reflect the ways technology is perceived to facilitate better networking, raising awareness, and creating a more welcoming environment for women. The presence of terms like "equality" and "female" reinforces the core subject of the research. Furthermore, words such as "training" and "culture" acknowledge the broader aspects necessary for successful integration and career development, areas where technology can play a supporting role, as discussed in the research participants' feedback regarding education and addressing industry culture. The word cloud visually confirms that the respondents' perspectives on technology's role are strongly oriented towards fostering diversity, providing opportunities, and building a supportive and inclusive environment for women in the maritime sector. Overall, the data suggests that technology is perceived as a crucial enabler for a more inclusive and equitable future workforce in the maritime industry.

4.5 Pathways to gender equity in maritime industry

To receive first-hand feedback from the women in the industry who participated in this research we asked their recommendations. To do that, we asked them five specific questions regarding the pathways to gender equity in maritime industry. The questions were:

a) What measures do you think could improve gender equality in the maritime industry?
b) What changes would you like to see in the maritime industry to support gender equality?
c) What role do you think international organizations (like IMO) play in promoting gender equality in maritime?

d) How do you think the maritime industry can attract more women to seafaring roles?

e) What advice would you give to young women considering a career in maritime?

The analysis of survey responses regarding "Pathways to Gender Equity in the Maritime Industry" reveals a multi-faceted approach and suggests essentials for fostering an inclusive and equitable future maritime workforce. Respondents provided comprehensive insights across various dimensions, from specific policy measures to the critical role of international organizations and personal advice for aspiring female seafarers.

For the measures to improve gender equality, respondents overwhelmingly emphasized the need for tangible policies and structural changes. "Equal pay" was identified as the most crucial measure, selected by 65% of respondents. This was closely followed by "Improved access to education and training" (58%), "Flexible working arrangements" (56%), and "Shifts in cultural norms" (56%). "Strict policies against discrimination" also garnered significant support at 52%.

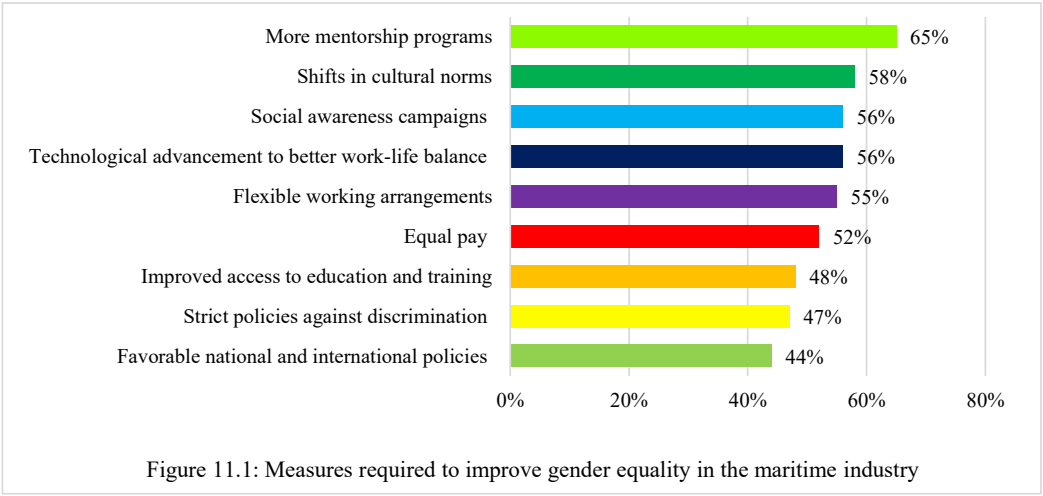


Figure 11.1: Measures required to improve gender equality in the maritime industry



Figure 11.2: Measures required to improve gender equality in the maritime industry

Qualitative feedback reiterated these priorities, with respondents calling for ***"Equal opportunity, better representation, and a cultural shift where respect and skill matter more than gender".*** The importance of implementing and enforcing anti-discrimination policies was also highlighted, with one respondent noting that ***"Most companies have policies but when these incidents happen there is always a reluctance to deal with it".*** This suggests a need not just for policies, but for robust enforcement and accountability.

When we asked about desired changes in the maritime industry to support gender equality, the "breaking stigma & stereotype to women" emerged as the top priority, selected by 72% of respondents. This underscores the deep-seated cultural barriers that need to be addressed. "More women in leadership positions" (64%) and "Ensuring equal treatment" along with "Equal pay enforcement" (both 62%) also received high endorsement. These findings collectively point to a desire for fundamental shifts in industry perception and power dynamics. The qualitative responses further reinforced the need for ***"comprehensive gender diversity policies and the involvement of male staff members in promoting gender equality,"*** stressing that ***"men and women should be treated equally in all respect"***.

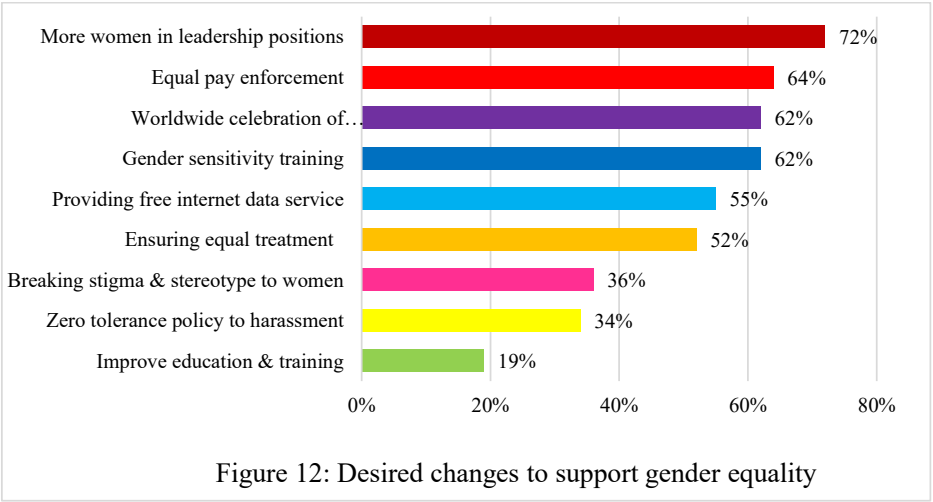


Figure 12: Desired changes to support gender equality

We further asked our respondents to suggest actions to attract more women to seafaring profession. Research participants responded that to attract more women to seafaring roles, there is a need to provide "Equal pay and career advancement opportunities" and "Enhancing work-life balance initiatives". These two factors were jointly ranked highest, both selected by 62% of respondents. "Changing cultural perceptions and gender biases" (59%) and "Improving workplace safety and harassment policies" (55%) were also deemed highly effective. The qualitative responses added that attracting women involves showing them a "***safe place in the maritime industry, safe from harassment and gender inequality"***, as well as promoting awareness of existing roles through outreach and early education initiatives.

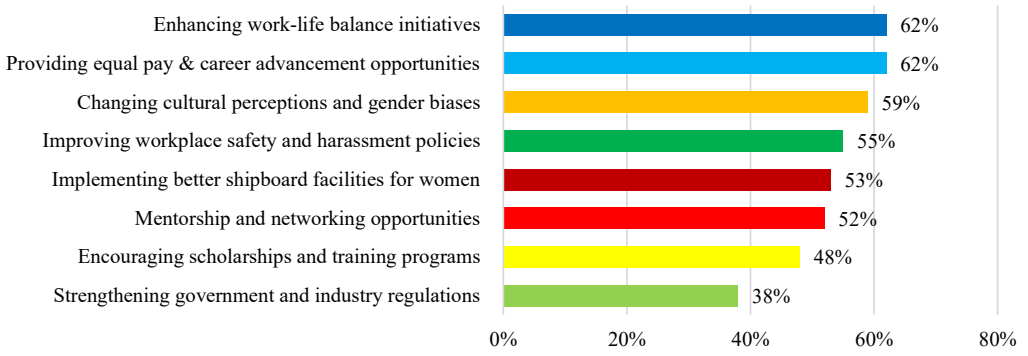


Figure 13: Suggestions for attracting more women in seafaring

The role of international organizations, such as the IMO, in promoting gender equality is largely perceived as critical. A combined 56% of respondents indicated that these organizations play a "Significant role" (41%) or a "Very significant role" (15%). Qualitative opinions elaborated on this, suggesting that IMO's role includes; implementing and promoting gender equality policies, supporting programs that encourage women in maritime careers, and influencing how companies operate within the sector. One respondent stated, ***"I think the IMO has a huge sway in the way that companies operate and have an ability to influence the maritime sector for good".***

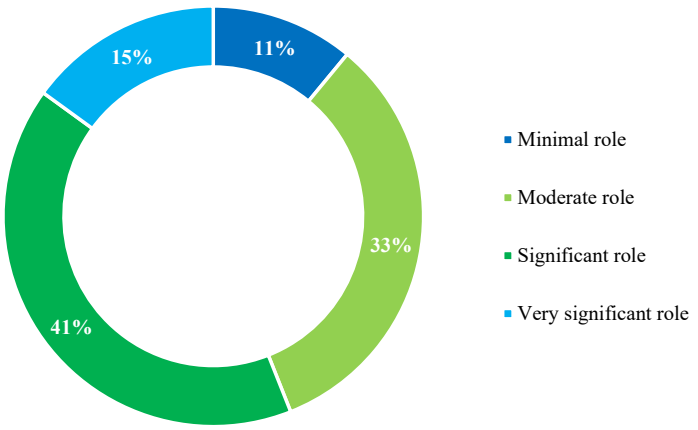


Figure-14: Perceived role of IMO in promoting gender equality

Finally, we seek their advice for encouraging the young women to consider a career in the maritime industry. This part heavily focused on individual attributes and proactive strategies for navigating the industry. The most frequently offered advice was to "Be mentally and emotionally strong" (67%), followed by "Be confident" (65%), and "Seek mentorship" (61%). Other significant advice included "Keep improving yourself" (60%) and "Be positive" (58%). Qualitative responses provided more nuanced guidance, such as being ***"100% prepared / mentally, morally, physically, emotionally…"***, emphasizing adaptability and the importance of

building strong networks of support. One respondent powerfully advised, ***"Maritime is not only for men; we, women, can also do it. Trust yourself".*** These responses collectively underscore the demanding nature of the profession while highlighting the personal fortitude and strategic engagement required for women to thrive.

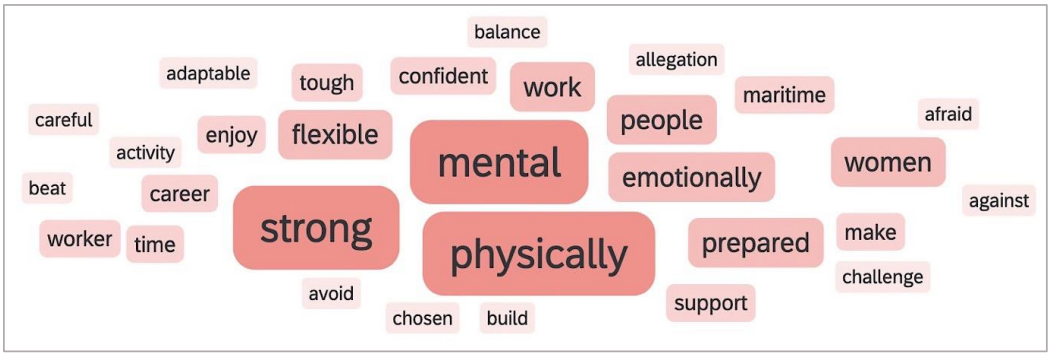


Figure 15: Suggestions for women aspiring seafaring professions

In conclusion, the aggregated findings from these analyses present a coherent roadmap towards achieving gender equity in the maritime industry. The perceived positive impact of technology, particularly in leveling the playing field and enhancing connectivity, is a foundational element. However, this must be complemented by fundamental shifts in industry culture, the dismantling of pervasive stereotypes, and rigorous enforcement of anti-discrimination policies. The strong emphasis on "diversity" and "opportunity" in the qualitative data, as reflected in the word cloud, underlines the overarching aspiration for an inclusive work environment. Pathways to equity, therefore, necessitate a holistic approach: fostering supportive leadership, enacting clear and enforceable policies, providing comprehensive education and training, leveraging technological advancements, and empowering individual women with the resilience and networks needed to support.

5. Discussion, Conclusion, and Recommendations

5.1 Introduction

This chapter encapsulates the core insights derived from the comprehensive analyses presented in Chapter 4, summarizing the key findings regarding factors influencing women's participation in seafaring, the transformative role of digitalization and technology, and the essential policy interventions required to foster gender-equality in maritime industry. It also highlights the broader significance of this research and outlines avenues for future research, culminating in a proposed framework that illustrates the interconnectedness of these critical elements.

5.2 Summary of Key Findings

The extensive investigation into women's participation in seafaring professions within an increasingly digitalized maritime landscape has revealed a complex interplay of multifaceted barriers and crucial enablers. This study investigated multifaceted barriers that impede women's participation in seafaring professions and explored how technological developments, especially digitalization and automation, can enhance gender equity in the maritime industry. Based on responses from 108 participants, including seafarers, shore-based professionals, and maritime stakeholders, the study revealed that a male-dominated culture, harassment and safety risks, work-family conflict, wage disparities, limited mentorship, and physical and psychological health challenges are the most critical barriers facing women in seafaring professions. Furthermore, while most respondents reported that their organizations support gender diversity, qualitative feedback exposed inconsistencies in implementation, particularly in mentorship, career advancement, and reporting mechanisms. However, many participants expressed optimism regarding the role of technology, especially in reducing physical burdens, enhancing connectivity, improving safety, facilitating training, enabling shore-based roles, and fostering a more inclusive work environment.

A male-dominated industry culture stands as the most substantial barrier, with a significant majority of respondents identifying it as such. Qualitative data further illuminates this challenge, frequently referencing terms such as "cultural," "gender," "discrimination," "stereotype," and "bias," which collectively contribute to an environment where women often experience doubt from others, feel pressured to constantly prove themselves, and are acutely aware of being outnumbered. Despite various initiatives aimed at promoting gender equality, these efforts are largely perceived as only "Moderately effective," indicating that while steps are being taken, a fundamental cultural shift is still a distant aspiration.

The presence of harassment and safety risks represents another critical impediment to women's participation. Approximately 40% of the respondents reported either directly experiencing or witnessing incidents of harassment or discrimination at sea. While the handling of these incidents received a mean score of 5 on a 7-point scale (where 7 signifies "Extremely well handled"), qualitative responses reveal inconsistencies in resolution and a persistent connotation of gender bias. For instance, some women noted that they "weren't taken as seriously," suggesting that even when incidents are reported, the response may not always be adequate or equitable. These safety concerns are not isolated but are intrinsically linked to broader physical and psychological health challenges, creating a reinforcing cycle that deters women from entering or remaining in seafaring careers.

Work-family conflict emerged as the third most significant negative factor impacting women seafarers. Quantitatively, a substantial proportion of respondents (36%) reported a "Significant impact" of family responsibilities on their career progression, with an additional 13% citing an "Extreme impact." Qualitative

insights underscore the profound difficulty of reconciling "Long months at sea make balancing family and career tough, especially for women," a challenge further compounded by prevalent societal expectations that often place a disproportionate burden of caregiving on women. The difficulty in balancing work and personal life is widely acknowledged, with 37% of respondents finding it "Moderately difficult" and 28% deeming it "Very difficult." To navigate this pervasive conflict, women primarily rely on "time management" and strive to "create an effective time management schedule that supports self-care and flexibility."

The absence of visible female role models and well-structured mentorship programs also poses a considerable barrier. While there is an observed gradual shift towards greater representation, the majority of the participants indicated the scarcity of female role models. This lack of visible leadership can significantly discourage aspiring women seafarers. Concurrently, while organizational support for gender diversity is perceived as adequate by over half of the respondents, a critical gap exists in the provision of structured career guidance. Although leadership training, technical skills development, and anti-harassment training are available, mentorship programs are notably scarce. Regarding wage disparity, a significant number of respondents believe it is not prevalent, asserting that salaries are based on rank rather than gender. However, a minority advocates for greater transparency through policies and reporting systems to ensure perceived fairness across all compensation structures.

In contrast to these barriers, technology is widely perceived as a powerful enabler for promoting gender equality in maritime careers. A strong majority of respondents expressed optimism, with 55% finding technology "Very helpful" and 27% deeming it "Moderately helpful" in this regard. Qualitatively, technology is seen to "levels the playing field, especially automation, digital tools and smarter ships," by reducing the traditional reliance on physical strength, thereby opening more opportunities for women. Furthermore, digitalization enhances connectivity, enabling better communication with family members during long voyages and potentially facilitating remote work arrangements. Technology is also viewed as a crucial tool for improving safety and security, facilitating virtual training and education, and creating new shore-based professional opportunities that may be more appealing or accessible to women.

5.3 Policy Interventions

To effectively foster a gender-equitable future workforce in the maritime industry, a comprehensive and specific policy interventions is imperative. These policies must directly address the identified barriers while strategically leveraging the transformative potential of technological advancements. Their successful development and rigorous enforcement will require concerted efforts from a diverse array of relevant authorities, including individual shipping companies, influential international maritime organizations such as the IMO, national governments, and specialized educational and training institutions.

5.3.1 Addressing Male-Dominated Industry Culture: Interventions in this area focus on systemic cultural biases, stereotypes, and discriminatory practices prevalent within the maritime industry. While many organizations may possess general anti-discrimination clauses, specific policies aimed at ingrained cultural norms and unconscious bias are often insufficient. Consequently, new, targeted policies are largely required, alongside significant amendments to existing general frameworks. Specifically, this necessitates the implementation of ***annual, mandatory gender sensitivity and unconscious bias training*** for all personnel, from entry-level seafarers to senior management, which can be efficiently delivered ***through online modules and interactive e-learning***

platforms. These technological solutions ensure widespread accessibility and consistent delivery of content focused on recognizing and mitigating biases, understanding gender-specific challenges, and fostering inclusive communication beyond basic anti-harassment training. Furthermore, measurable ***Key Performance Indicators (KPIs) related to diversity and inclusion should be integrated*** into performance reviews for all management levels, ***with HR analytics dashboards and data visualization tools*** providing real-time insights into female representation in leadership, equitable promotion rates, and feedback from diversity surveys. Additionally, clear guidelines for inclusive language and imagery must be developed and enforced in all internal and external communications, with digital content management systems and AI-powered language checkers assisting in promoting a welcoming and gender-neutral environment.

As a best practice, the International Transport Workers' Federation (ITF) has long advocated for comprehensive policies addressing discrimination, with their ***"Fair Practices Guide"*** including provisions for cultural change. Similarly, reputed shipping companies like Maersk have implemented internal ***Diversity and Inclusion (D&I) programs*** that incorporate unconscious bias training and leadership accountability for diversity metrics, aiming to shift long-standing cultural norms. The responsibility for these interventions lies with shipping companies (specifically HR departments, senior leadership, and D&I committees), national maritime authorities (for regulatory oversight and the implementation of best practice), and the IMO (for setting international standards and guidelines).

5.3.2 Combating Harassment and Ensuring Safety: This area of intervention focuses on the prevention, reporting, investigation, and resolution of harassment and discrimination incidents, alongside enhancing both physical and psychological safety for women seafarers. Although most companies have ***anti-harassment policies***, their effectiveness is frequently undermined by inconsistent application, a lack of transparency, and fear of retaliation. Therefore, critical amendments are required to strengthen existing policies, and new mechanisms are needed to ensure robust, independent oversight. Policies must be amended to explicitly state a ***zero-tolerance approach to harassment and discrimination***, accompanied by a clear, progressive disciplinary framework with transparent sanctions. It is crucial to ***establish multiple, easily accessible, and genuinely confidential reporting channels,*** such as dedicated anonymous hotlines, independent third-party ombudsmen, or secure digital platforms. This directly addresses the qualitative finding that "How it's handled depends on the leadership; good officers shut it down, but there's still a long way to go," highlighting the need for consistent, non-leadership-dependent channels. Furthermore, policy must mandate prompt, impartial, and thorough investigations conducted by trained personnel, with clear timelines for resolution and transparent communication of outcomes to all relevant parties while respecting privacy. Policies must also guarantee comprehensive victim support and protection, including access to psychological counseling, transfer options, and explicit safeguards against retaliation, facilitated ***by tele-counseling platforms and secure digital communication tools for remote support***.

From a technological standpoint, it is imperative to develop and implement ***secure digital reporting systems, such as mobile apps for women seafarers***, that allow for anonymous submissions, timestamping, and evidence upload. Consideration should also be given to the ***use of AI for pattern recognition in reported incidents***, with strict privacy protocols, to identify systemic issues. The Maritime Labour Convention (***MLC, 2006***) provides a foundational framework for decent working conditions, including safety, but specific anti-harassment protocols typically fall under national regulations and company policies. The UK Chamber of Shipping's ***'Guidance on Eliminating Harassment and Bullying in the Maritime Sector'*** offers a comprehensive industry-specific

approach, and some progressive companies are actively exploring independent reporting mechanisms and digital platforms to enhance trust and accessibility for women seafarers. Responsible authorities for taking appropriate actions on the above-mentioned recommendations include- shipping companies (legal, HR, D&I departments), national maritime authorities (for regulation and enforcement), flag states (for compliance), and the IMO (for setting international guidelines and conventions).

5.3.3 Mitigating Work-Family Conflict: Interventions in this domain aim to establish flexible working arrangements, robust family support structures, and policies that specifically acknowledge and address the unique challenges of women seafarers with family responsibilities. While some companies may offer basic leave policies, comprehensive work-life balance policies tailored for seafarers, particularly women, are often lacking, necessitating the formulation of new policies to address the distinct demands of the profession. Key policy recommendations include ***developing provisions for more flexible contract lengths and predictable rotation schedules*** which can be significantly aided by ***advanced crew scheduling software and optimized logistics platforms***. This would enable women to better plan for family commitments and directly address the concern that "Long months at sea make balancing family and career tough." Furthermore, implementing ***maternity leave policies*** that exceed minimum national requirements, including provisions for childcare support or subsidies, is crucial. For shore-based positions, ***remote work policies*** that leverage technology to allow flexibility should be established, supporting women transitioning from sea or managing family responsibilities. Finally, ***ensuring reliable and affordable internet access onboard for seafarers*** is vital to enable them to maintain regular contact with families, thereby mitigating the sense of isolation and aiding work-life balance. Moreover, technological development now enables seafarers to access ***the tele-medicine services for health and well-being support***.

While comprehensive examples are still emerging, some Scandinavian shipping companies are experimenting with more flexible contract arrangements and enhanced family support, with the Norwegian Shipowners' Association having initiatives promoting work-life balance. The International Seafarers' Welfare and Assistance Network (ISWAN) actively advocates for improved onboard connectivity as a fundamental welfare measure. The responsible authorities for implementing these policies include- shipping companies (HR and operational management), labor unions (for collective bargaining agreements), national maritime authorities (for labor laws), and the IMO (for promoting seafarer welfare guidelines).

5.3.4 Enhancing Role Models and Mentorship: This area of intervention focuses on increasing the visibility of female leaders and establishing formal mentorship and sponsorship programs within the maritime industry. Currently, formal mentorship programs specifically designed for women in maritime are largely absent or informal, necessitating the creation of new, structured policies to address the "scarcity of female role models." Policy recommendations include establishing structured, company-wide mentorship programs that formally pair aspiring and current women seafarers with experienced professionals (both male and female) who can provide crucial career guidance, support, and advocacy. These programs can be significantly enhanced by **online mentorship platforms** that facilitate connections regardless of geographical location, offering features like virtual meeting scheduling, progress tracking, and resource sharing. Alongside this, implementing sponsorship initiatives where senior leaders actively champion and advocate for high-potential women is vital, helping them navigate career pathways and access leadership opportunities. Furthermore, creating targeted leadership training and development programs specifically designed to equip women with the skills and confidence for senior roles would

directly address the finding of "limited female leadership," with **e-learning modules, virtual reality (VR) simulations for leadership scenarios, and online workshops** providing accessible and flexible training. Finally, proactive visibility initiatives are needed to actively promote and highlight the achievements of women in maritime through internal communications, industry events, and public relations, leveraging **social media campaigns, digital storytelling, and dedicated online profiles** to increase the presence of accessible role models. Organizations like WISTA International (Women's International Shipping & Trading Association) already run informal and formal mentorship programs, and larger corporations outside of the maritime sector, such as IBM or Deloitte, offer well-established global mentorship and sponsorship programs that could serve as effective models for the maritime industry. The responsible authorities for these initiatives include shipping companies (HR, D&I departments, and senior leadership), professional maritime associations, and educational and training institutions.

5.3.5 Ensuring Equal Opportunities and Comprehensive Support: This area of intervention encompasses ensuring equitable access to training, fair compensation, and fostering overall supportive organizational environments for women in maritime. While the principle of equal opportunity is often stated, specific policies ensuring equitable access and transparent compensation require significant strengthening, necessitating amendments to existing training and compensation policies. Key policy recommendations include implementing gender-neutral recruitment and promotion policies, such as **blind recruitment processes facilitated by applicant tracking systems that anonymize candidate data**, and ensuring that all promotion criteria are objective and free from gender bias. It is crucial to establish clear, transparent wage structures based solely on rank, experience, and performance, independent of gender, and to conduct regular, independent wage audits to identify and rectify any disparities, utilizing **digital pay systems and HR analytics tools** for real-time monitoring and analysis. This directly addresses the qualitative comments advocating for "Implementation of gender equal pay policy and reporting system." Furthermore, policies must ensure women have equitable access to all specialized training and development opportunities, including technical and leadership courses, without implicit or explicit barriers, with **online learning platforms and virtual simulation tools** providing flexible and accessible training options. Lastly, it is essential to mandate and ensure that shipboard facilities, including accommodation and sanitary facilities, are adequate and appropriate for women, addressing fundamental comfort and privacy needs. The International Labour Organization (ILO) Convention 188 on Work in Fishing, which includes provisions for decent working conditions, can serve as a foundational framework for adaptation. Additionally, some national maritime academies are actively reviewing their curriculum and facilities to be more gender-inclusive, representing a best practice. The responsible authorities for these policies include shipping companies (HR and operations departments), national maritime authorities, labor unions, and educational and training institutions.

5.4 Framework for a Gender-Equitable Maritime Future Workforce

This framework for a "Gender-Equitable Maritime Future Workforce" visually delineates the interplay between key barriers hindering women's participation, the transformative role of technology, and the specific measures required to foster equity in the maritime industry. The framework is structured around five most significant barriers found in this study- wage disparities, absence of mentorship, work-family conflict, male-dominated industry culture, and harassment & safety risks. Additionally, it identifies broader systemic issues such as lack of strict policies, educational inequalities, and company policies as contributing factors.

For each identified barrier, the framework proposes specific measures. For instance, addressing the *'male-dominated industry culture'* involves mandatory bias training, D&I KPIs for management, and inclusive language guidelines. Combating '*harassment and ensuring safety'* necessitates a zero-tolerance policy with sanctions, confidential reporting channels, mandatory and impartial investigations, and victim support and protection. Mitigating *'work-family conflict'* is tackled through flexible contracts and predictable schedules, comprehensive family leave, remote work options, and reliable onboard internet. Enhancing '*role models and mentorship'* is facilitated by formal mentorship and sponsorship, targeted leadership programs for women, and promotion of women's achievements. Lastly, '*ensuring equal opportunities'* includes gender-neutral recruitment and promotion, transparent wages and audits, equitable training access, and inclusive shipboard facilities.



Figure 1: Framework for a Gender-Equitable Maritime Future Workforce

IAMU International Association of Maritime Universities (AMC)

Most significantly, the framework emphasizes the pivotal role of technology & digitalization in implementing these measures and promoting gender diversity. For each set of measures, specific technological tools are highlighted. For cultural transformation, online modules, e-learning platforms, HR analytics dashboards, data visualization tools, digital content management systems, and AI language checkers are key. In combating harassment, secure digital platforms, mobile apps, AI for pattern recognition, tele-counseling platforms, and secure digital communication tools are vital. For work-family balance, advanced crew scheduling software, optimized logistics platforms, video conferencing, cloud collaboration tools, secure VPNs, and enhanced onboard connectivity are essential. To boost mentorship and role models, online mentorship platforms, Virtual Reality (VR) simulations, online workshops/e-learning modules, social media campaigns, and digital storytelling are leveraged. Finally, for ensuring equal opportunities, applicant tracking systems with anonymization, digital pay systems, HR analytics tools, and online learning platforms and virtual simulation tools are instrumental. The connected coloring between barriers and measures visually suggests that each set of policy interventions is directly designed to counteract a specific impediment, while technology acts as an overarching enabler for all these efforts.

5.5 Significance of the study and future research agenda

This study is highly significant within the evolving maritime discourse, offering a timely and in-depth empirical analysis of the diverse factors affecting women's participation in the seafaring profession. Through a robust mixed-methods approach, it blends statistical breadth with qualitative depth, capturing both measurable trends and lived experiences. A key contribution lies in its exploration of digitalization as a transformative tool for gender equity, revealing how technology can reduce physical demands and enhance inclusion. The study concludes with practical policy recommendations, offering stakeholders a strategic roadmap to foster a more inclusive, resilient, and sustainable maritime workforce.

Building upon the foundational insights generated by this study, several promising avenues for future research are recommended for further advance of gender equity in the maritime industry. ***Firstly,*** conducting rigorous longitudinal studies to assess the actual impact and long-term effectiveness of implemented policy interventions is crucial. Such studies would provide invaluable data on women's retention rates, their career progression trajectories, and their overall well-being in seafaring environments following policy changes. ***Secondly,*** cross-cultural comparative studies are essential to explore how the factors affecting women's participation and the efficacy of various policies differ across diverse cultural contexts and maritime regions. This would facilitate the identification of global best practices and highlight context-specific challenges that require tailored solutions.

Thirdly, a deeper dive into the specific technological interventions and their precise impact is warranted. Future research could investigate how advanced automation, artificial intelligence in human resources, or the proliferation of remote operation centers specifically reduce gender-specific barriers and create novel opportunities for women. ***Fourthly,*** dedicated research focusing on the mental health and well-being challenges faced by women seafarers is imperative, particularly those stemming from harassment, isolation, and the persistent work-family conflict. This research should also evaluate the effectiveness of existing and proposed support systems tailored to the unique realities of life at sea.

Fifthly, exploring the role of male allies in promoting gender equality and investigating the design and implementation of effective mentorship programs specifically tailored for women in maritime would provide practical insights into fostering supportive professional networks. ***Finally,*** quantifying the economic benefits of increased women's participation and enhanced gender equality for shipping companies and the broader maritime

industry is a vital area for future inquiry. Providing a robust business case for diversity initiatives can significantly accelerate their adoption and investment across the sector.

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