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Research Paper

Core Competencies and Technological Skills of Maritime Professionals In the Fourth Industrial Revolution Towards a Strategic Plan

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Abstract

As the maritime industry evolves in the Fourth Industrial Revolution (4IR), understanding the competencies and technological skills needed for Filipino maritime professionals is vital for addressing skills gaps and aligning emerging industry needs to maintain competitiveness in the global workforce. The study identified the core competencies and technological skills of maritime professionals in the 4IR, informing a strategic plan. A descriptive comparative-correlational research design was employed, covering 121 maritime professionals from MHEIs, shipping companies, and training centers. Snowball sampling was utilized to efficiently access deck and engine officers. The statistical tools used in treating the data were: frequency and percentage distribution for demographic profiles, weighted arithmetic means for core competencies and technological skills assessments, and Pearson correlation coefficients to explore relationships between competencies and technological skills. The Kruskal-Wallis H test was used to assess the significant difference in respondents' core competencies and technological skills by profile. Findings of the study revealed that respondents demonstrated average to above-average proficiency in various technical and digital skills. The correlation analysis reveals strong positive relationships between various competencies and technological skills. Competencies in technical and cybersecurity were average; strengths were noted in innovation, adaptability, digital literacy, and regulatory compliance. Significant differences were found in specific technological skills, such as automation and robotics, indicating a need for targeted training in advanced technologies. The findings underscore the importance of aligning specialized training with emerging industry demands. Likewise, fostering a culture of innovation and integrating continuous education opportunities is essential to address gaps in advanced technological skills.

Keywords: *Core Competencies; Digital Literacy; Fourth Industrial Revolution; Maritime Professionals; Technological Skills*

INTRODUCTION

The maritime industry, as the cornerstone of global trade and business, is undergoing a profound transformation and colossal change brought about by the Fourth Industrial Revolution (4IR). The 4IR, which involves the integration of advanced technologies, has ushered in a new era in which vessels, ports, and maritime operations are becoming increasingly digitized and interconnected.

The 4IR is changing the face of industry worldwide, and the maritime sector is included. This revolution's convergence of digital, physical, and biological technology has led to significant progress in the maritime sector, including the creation of innovative ships and intelligent ports. This revolution is being driven by maritime professionals such as mariners, naval architects, marine engineers, and port personnel. To succeed in this modern era, those working in the maritime industry must possess a particular set of fundamental competencies, skills, and expertise that meet the requirements for the Fourth Industrial Revolution (4IR).

The Maritime Industry Authority reports that over 385,000 Filipino seafarers are deployed; however, rapid technological advancements in the industry pose challenges, necessitating new competencies and skills for competitiveness in the global market (MARINA Maritime Statistical

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Report, 2022).

The 4IR has a significant impact on maritime professionals in the Philippines, a maritime nation with a rich seafaring tradition. The Philippines is one of the world's largest providers of seafarers, with thousands of Filipino seafarers employed on ships worldwide. Nonetheless, Filipino maritime professionals are facing challenges due to the rapid technological advancements in the maritime industry. These challenges include the need for new competencies and skills in order to maintain a competitive advantage in the global market. Research on the specific skills and competencies that maritime professionals in the Philippines must possess in the context of the 4IR is scarce, despite the importance of these competencies and skills.

Limited research has been conducted on the core competencies and technological skills of maritime professionals to ensure their success and maintain competitiveness in the global maritime workforce. Despite various efforts and initiatives, the competencies and technological skills of maritime professionals remain insufficient to meet the demands of the 4IR in the maritime industry.

This gap hinders the development of effective training programs and policies that could help Filipino maritime professionals acquire the necessary skills to meet 4IR requirements and boost their competitiveness in the global maritime industry. The purpose of this study is to identify the fundamental competencies and technological skills of maritime professionals in the Philippines using the 4IR framework. This investigation also serves the additional purpose of identifying the core competencies and technological skills that Filipino maritime professionals will need to excel in the 4IR. Therefore, the goal of this research is to provide policymakers, educators, and training providers with practical suggestions on how to develop targeted training programs that enhance the ability of Filipino maritime professionals to adapt to and prepare for the challenges and opportunities presented by the 4IR.

The study identified the core competencies and technological skills of maritime professionals in the 4IR to inform a strategic plan. The study examined the profile of the respondents in terms of age, sex, educational attainment, years of experience in the maritime industry, maritime rank or current position, affiliated institution, and relevant seminars and training attended. It also assessed the respondent's core competencies regarding technical competency, cybersecurity, innovation and adaptability, digital literacy, and regulatory compliance knowledge. Furthermore, the study evaluated the respondents' technological skills in various areas, including automation and robotics, digitalization and data analytics, artificial intelligence, advanced navigation systems, remote sensing and satellite communication, virtual and augmented reality, and sustainable technologies. The study then examined whether a significant relationship existed between the core competencies and technological skills of maritime professionals, and whether there were significant differences in these competencies and technological skills when grouped according to their profiles. Lastly, based on the study's findings, what strategic plan could be proposed to address the challenges of the 4IR?

LITERATURE REVIEW

Fourth Industrial Revolution (4IR)

In 2011, the notion of Industry 4.0 was first introduced. As a groundbreaking process, Indutry 4.0 seeks to integrate various dimensions of information and communication technology (ICT) while promoting digitalization and information-driven industrial development (Salleh et al., 2021). The Fourth Industrial Revolution, also known as Industry 4.0, highlights the industrial industries' digitalization. The transformation of organizations to the digital form is commonly known as Industry 4.0. Industry 4.0 and digitalization are strongly interconnected, as digitalization significantly contributes to the realization of Industry 4.0. As such, digitalization will be the key

vehicle of innovation and transformation in the near future (Jahn & Saxe, 2017).

However, there is no universal definition of Industry 4.0. A few scholars have viewed it as a process of increasing digitization and automation in the industrial sector. A few others, highlighting an outcome-oriented perspective, suggest Industry 4.0 signifies a fresh chapter or paradigm for industrial production. Other scholars have referred to Industry 4.0 as an umbrella term for new technologies and technological concepts. The transition to Industry 4.0 can have a crucial impact on manufacturing firms' ability to gain a competitive advantage and seize new opportunities (Weking et al., 2020).

Maritime Industry 4.0

The shipping industry is also a synonym for global trade as it is the major player in the trading industry (Struck, 2020). The fact that 90% of global trade is conducted through the sea underscores the shipping industry's pivotal role in supporting the world's economy (Emad et al., 2021). Therefore, the new generation of Industry 4.0 technologies, such as autonomous ships, has the potential to address the challenges in the maritime domain (Gu et al., 2021). The maritime industry tends to adapt as technologies develop, consistently changing the nature of its operations and seeking to utilize new technologies in various areas. Today's global maritime sector relying increasingly on digitalization, integration of operations, and automation (Androjna et al., 2020). In this context, autonomous technologies have gained prominence and have the potential to revolutionize the character of the shipping industry (Ghaderi, 2018). In order to remain competitive and innovative in the ever-evolving maritime sector, it is important to understand and capitalize on industry trends. The drivers of these trends are new technologies related to autonomous ships and maritime autonomy. The integration of autonomous technologies in the maritime industry suggests the need for an interdisciplinary education that combines traditional maritime skills with state-of-the-art technological expertise. This educational adaptation is important not only for the current workforce but also for future generations of seafarers entering this, as it prepares them to capitalize on the potential benefits of autonomous shipping (Mestrovic et al., 2024).

Maritime 4.0 seeks to redesign supply chains in the maritime industry through digitalization and interconnecting (Jahn & Saxe, 2017). This development offers several significant advantages, including generating new value, fostering cooperation between port personnel, reducing operational costs, and increasing total revenue (Aiello et al., 2020). The maritime industry 4.0 is part of the 4IR, where technology, innovation, and the use of data converge. Unlike its predecessors, it develops faster, and its impact is evident in every aspect of the industry, resulting in a massive change in the way we move, communicate, and work (Cargofive, 2024).

The impact of the 4IR is evident across the maritime domain, encompassing ports, shipping, and their operations and services (Sullivan et al., 2020). The implementation of Industry 4.0 in the maritime industry requires all sectors to connect and grow simultaneously. This can be considered as not a challenge but an opportunity for the maritime domain, which requires improved connectivity between ports and ships. This may imply that ships and ports consider the retrofitting process through digitalization (Quitzau et al., 2018). The maritime industry, like other industries, is embracing Industry 4.0 by adopting new technologies digitalized at various levels (Jo & D'Agostini, 2020).

Competency and Skill Development

The maritime industry is undergoing a profound transformation with the integration of autonomous technologies, which brings new challenges and opportunities for the education and training of seafarers (Mestrovic et al., 2024).

The 4IR entails the modernization of work, which is likely to have a significant impact on the employment, training, competencies, and technological skills of maritime professionals in the foreseeable future skills and competencies for maritime operations tend to focus on technology as a requirement for workers to adapt to changes. This technology-centered approach can be controversial, as technology cannot dictate how humans work or how they choose their careers after graduation (Talmor & Kitada, 2022).

Future seafarers are expected to work on autonomous ships, whose systems and operations are increasingly influenced by advancements in technology and digital services. This implies that the skills and competencies outlined for current seafarers by the Standards of Training, Certification, and Watchkeeping (STCW) Code (last revised in 2011) to operate nonautonomous ships may need to be supplemented with new skills and competencies based on the threat of becoming redundant in the near future. The skills and competency framework developed for the future seafaring workforce should not only address the skills gap but also allow the matching of the right seafarer with the required skills. The framework will indicate the position and the level of competencies required for the seafarer to succeed in roles influenced by evolving technologies and increasing automation. It is a fact that competencies vary according to the assigned job/tasks and differ at different levels (Ghosh & Emad, 2024).

To stay updated on the latest technological advancements, the maritime industry, and particularly the seafarers, must engage in ongoing learning that includes participation in training programs focused on digital skills, adaptability, and problem-solving. By continuously enhancing their skills, seafarers can contribute to industry growth and remain competitive in the evolving maritime industry. The importance of soft skills alongside technical abilities helps identify areas for improvement, guiding the development of targeted training programs. It encompasses key factors such as adaptability, digital literacy, and problem-solving, which are essential for success in the 4IR maritime industry.

RESEARCH METHOD

A descriptive comparative-correlational research design was employed to investigate the core competencies and technological skills of maritime professionals, specifically deck and engine officers, within the context of the 4IR. The study was conducted in selected maritime higher education institutions (MHEIs), shipping companies, and training centers. It also included maritime professionals currently working on board vessels as part of the shipping companies. Snowball sampling was employed to enlist deck and engine officers, resulting in a sample of one hundred twenty-one (121) participants. The reliability test was performed to measure the internal consistency of the items included in the survey questionnaire.

The reliability test, conducted to measure the internal consistency of the items included in the survey questionnaire, was assessed using Cronbach's Alpha, a widely recognized measure for internal consistency. The researcher-made questionnaire was used to gather pertinent data which were analyzed and interpreted using the frequency and percentage distribution for demographic profiles, weighted arithmetic means for core competencies and technological skills assessments, Mann Whitney U test was used to determine significant difference in the core competencies and technological skills for two groups like attendance or non-attendance in relevant seminars, trainings and conferences and Pearson correlation coefficients to explore relationships between competencies and technological skills. The Kruskal-Wallis H test assesses a significant difference in respondents' core competencies and technological skills when grouped according to their profiles.

FINDINGS AND DISCUSSION

Profile of the Maritime Professionals

Table 1. Frequency and Percentage Distribution of the Respondents' Profile

Demographic Characteristics	*f*	%
Age		
21-30	13	10.74
31-40	21	17.36
41-50	33	27.28
51-60	8	12.4
61 - 65	24	19.83
66 and above	15	12.40
Sex		
Male	121	100/00
Educational Attainment		
Bachelor's Degree	24	19.80
Bachelor's Degree with Master's Units	57	47.10
Master's Degree	34	28.10
Master's Degree with Doctoral Units	6	5.00
Years of Experience in the Maritime Industry		
10 years and below	16	13.3
11-20	34	28.1
21-30	23	19
31-40	25	20.7
41-55	23	19
Total	121	100.0

In terms of age, the largest group of respondents falls in the 41-50 years category, accounting for 33 individuals (27.28%). In contrast, the 21-30 age group is the smallest, with only 13 respondents (10.74%), indicating minimal representation from younger professionals. This aligns with the findings that a significant number of seafarers are concentrated in the 30-49 age range, indicating a strong presence of professionals in mid-to-late career stages (Huerte et al., 2023).

Regarding sex, the entire sample consists of 121 males (100%), highlighting the absence of gender diversity among the respondents. Seafaring is a male-dominated occupation where the vessel serves as both a workplace and a home, with seafarers living and socializing on board for weeks to months. The challenges of being away from home can complicate recruitment for onboard positions (Boström, 2025). This finding is consistent with the International Maritime Organization's (2022) report, which highlights the significant gender imbalance in the maritime industry, where women constitute less than 2% of the global seafaring workforce.

Regarding educational attainment, 57 (47.10%) respondents hold a bachelor's degree with master's units, indicating that almost half are inclined towards higher education, where 6 (5%) of the respondents hold a master's degree with doctoral units, demonstrating that there is a small group obtaining a high level of education. This may be attributed to the industry's demand for meeting its requirements, a trend corroborated by the study, which indicates that maritime professionals are increasingly pursuing higher education (Toriia et al., 2023).

With reference to the years of experience of the respondents, 34 (28.1%) have 11-20 years of experience. There are only 16 (13.3) respondents who have 10 years or less experience. The distribution shows a minor difference in the number of respondents per years of experience bracket. This supports the findings that maritime professionals tend to stay in their work for long years (Lagdami & Bellini, 2023).

Table 2. Profile of the Respondents as to Maritime Rank, Affiliated Institution and Relevant Training and Seminar Attended

Demographic Characteristics	*f*	%
Maritime Rank/ Current Position		
Chief Engineer	37	30.6
Ship Captain	36	29.8
Third Engineer	5	4.1
Second Engineer	24	19.8
Third Officer	4	3.3
Chief Officer / Mate	7	5.8
Second Officer	8	6.6
Affiliated Institution/Organization		
Training Institution	27	22.3
Academy	39	32.2
Shipping Company	55	45.5
Relevant Seminars/Trainings/Conferences Attended		
Regulatory Compliance Knowledge	79	65.3
Cyber Security	69	57.00
Maritime Innovation and Adaptability	60	49.6
Advanced Technological Navigation Systems	53	43.8
Smart Ship Navigation System	37	30.6
Sustainable Technologies	36	29.8
Digital Literacy	27	22.3
Automation and Robotics	23	19.0
Virtual and Augmented Reality	15	12.4
Artificial Intelligence	11	9.10
Digitalization and Data Analytics	6	5.0
Remote Sensing and Satellite Communications	5	4.1

The distribution of maritime rank or present job indicates that many respondents hold senior positions, suggesting that their viewpoints are formed by broad leadership and technical responsibilities. Most are Chief Engineers or Ship Captains, indicating that experienced leaders are common (Kazantsev, 2023). This distribution shows a comprehensive representation from both operational and educational/training sectors of the industry, ensuring a diversified range of insights. This supports the finding that many maritime professionals work for shipping companies and MHEIs, reflecting diversity in operational and training sectors (Asian Institute of Maritime Studies, 2022).

The most attended seminars and trainings cover regulatory compliance, cybersecurity, and maritime innovation. It appears that AI and data analytics are neglected in favor of traditional and regulatory knowledge. This supports the idea that seamen value traditional regulatory training above AI and data analytics, which are growing in popularity but are underrepresented (Toriia et al., 2023).

Core Competencies of the Maritime Professionals in the Fourth Industrial Revolution (4IR)

Table 3. Summary Mean Ratings of the Core Competencies of the Respondents in the 4IR

Area Indicators	Mean	Interpretation
Technical Competency	3.42	Average Competency
Cyber Security Competency	3.23	Average Competency
Innovation and Adaptability Competency	3.62	Above-Average Competency
Digital Literacy Competency	3.53	Above-Average Competency

Area Indicators	Mean	Interpretation
Regulatory Compliance Knowledge Competency	4.13	Above-Average Competency
Composite Mean	3.53	Above Average Competency

The respondents have an average competency in technical competency (WM = 3.42), which ranks 4th among the 5 area indicators. They also have an average competency in Cyber Security (WM = 3.23), ranking 5th, which indicates a baseline level of proficiency in handling cybersecurity issues. However, there may be room for further enhancement in this crucial area. In terms of Innovation and Adaptability Competency (WM = 3.62) and Digital Literacy Competency (WM = 3.53), both fall within the above-average competency range, indicating that the respondents are relatively more adept at adapting to innovative processes and new technologies.

Regarding Regulatory Compliance Knowledge Competency (WM = 4.13), which ranks first, the respondents have an above-average competency. This indicates that the respondents possess knowledge and can adhere to the rules and regulations. This is important to ensure ethical practices and adherence to legal standards. Additionally, it is crucial in other fields such as financial matters, data privacy, and other activities that are being regulated.

Finally, the overall mean of 3.53 on the core competencies of the respondents in the 4IR is above average. This indicates that the respondents have the knowledge and skills. However, improvements and development in cybersecurity and technical skills aspects can still be made to achieve a higher overall level of competency. These findings align with the understanding among maritime professionals that they need to improve their technical skills, recognizing areas where their training and work experience are lacking. They emphasize the importance of making maritime training programs more adaptable to meet the changing needs of the maritime industry (Sharma & Kim, 2021).

Technological Skills of the Maritime Professionals in the Fourth Industrial Revolution (4IR)

Table 4. Summary of the Respondents' Mean Ratings of Their 4IR Technological Skills

Area Indicators	Mean	Interpretation
Automation and Robotics	3.10	Average Proficiency
Digitalization and Data Analytics	2.81	Average Proficiency
Artificial Intelligence	2.75	Average Proficiency
Advanced Navigation System	3.47	Average Proficiency
Remote Sensing and Satellite Communication	3.11	Average Proficiency
Virtual and Augmented Reality	2.57	Average Proficiency
Sustainable Technologies	3.81	Average Proficiency
Composite Mean	3.09	Average Proficiency

For Automation and Robotics, the weighted mean (WM = 3.10) ranking 4th among seven indicators, shows a foundational level of competence, essential for industries that increasingly rely on automation. In the areas of Digitalization, Data Analytics, and Artificial Intelligence, the skills are somewhat lower, with weighted means (MW = 2.81) and (MW = 2.75), ranking fifth and sixth, respectively, suggesting a basic familiarity but also pointing to potential areas for development given their growing importance in decision-making and operational efficiencies.

The Advanced Navigation System shows a relatively high skill level (WM = 3.47), indicating a more advanced understanding of technologies crucial for transportation and logistics sectors. Similarly, Remote Sensing and Satellite Communication have a weighted mean (WM = 3.11), indicating reasonable capabilities in these technologies critical for geographic data gathering and communication.

However, Virtual and Augmented Reality score the lowest among the evaluated skills, with a weighted mean (WM = 2.57), suggesting less familiarity with these emerging technologies that have significant applications in training, marketing, and entertainment. On the other hand, Sustainable Technologies exhibit the highest proficiency, with a weighted mean (WM = 3.81), highlighting a strong understanding and capability in implementing technologies that support sustainable practices.

Overall, the composite mean of all areas stands at (WM = 3.09), confirming a general, yet varied level of expertise across these critical technological fields. To keep pace with industry advancement, maritime professionals require additional training in automation, robotics, digitalization, and data analytics (Gullick, 2023). Artificial Intelligence (AI), with its processing capabilities and ability to integrate multiple vessel systems, has the potential to enhance and improve various tasks on vessels. The maritime industry is increasingly interested in applying advanced AI technologies to address issues related to sustainability, efficiency, and regulatory compliance (Tuński et al., 2024).

Significant Relationship between the Core Competencies and Technological Skills of the Maritime Professionals in the Fourth Industrial Revolution

Table 5. Pearson r Data to Determine Significant Correlation Between the Technical Core Competencies and the Technological Skills of the Respondents in the 4IR

Variable	r (Correlation Coefficient)	Significance (2-tailed)	Interpretation
Core Competencies and Technological Skills	0.848	0.000	Strong positive correlation, statistically significant; reject Ho

Technical Core Competencies and Technological Skills had a high positive correlation (r = 0.848). This suggests that technology skills will improve as technical core competence does. A two-tailed significance value (p) of 0.000 confirms the correlation's dependability. These data indicate that improving technical competence highly correlates with better technological skills, highlighting their interrelationship in skill development. A study indicated that firms with higher core technology competency had more substantial competitive advantages, showing that better technical capabilities lead to better technological results (Liu & Yang, 2021). This supports the idea that technical abilities and technological skills are strongly correlated, meaning that improving one would increase the other (Popoola et al., 2024). Another study emphasizes the need for technical and technological abilities in modern educational and professional settings (Gullick, 2023).

Significanct Difference in the Core Competencies and Technological Skills of the Respondents in the Fourth Industrial Revolution when Grouped According to their Profile

Table 6. Kruskal–Wallis H Test Data to Determine Significant Difference in the Core Competencies and Technological Skills of the Respondents when Grouped According to Their Profile

Profile Variable	Core Competencies				Technological Skills			
	Chi-Square	p-value	df	Interpretation/ Decision	Chi-Square	p-value	df	Interpretation /Decision
age	68.25	.001	37	Significant, Reject Ho	63.139	.005	37	Significant, Reject Ho
education	24.76	.000	3	Significant, Reject Ho	16.007	.001	3	Significant, Reject Ho

Profile Variable	Core Competencies				Technological Skills			
	Chi-Square	p-value	df	Interpretation/ Decision	Chi-Square	p-value	df	Interpretation /Decision
years of experience	68.288	.001	35	Significant, Reject Ho	63.964	.002	35	Significant, Reject Ho
Maritime Rank	27.412	.000	7	Significant, Reject Ho	22.482	.002	7	Significant, Reject Ho

When profile variables group respondents, the Kruskal-Wallis H test shows significant differences in Core Competencies and Technological Skills. Age-related chi-square values of 68.25 (p=0.001) for core competencies and 63.139 (p=0.005) for technological skills demonstrate that abilities and skills vary across age groups, possibly due to experience and flexibility. Educational background also has a substantial impact, with chi-square values of 24.76 (p=0.000) for core competencies and 16.007 (p=0.001) for technological abilities, highlighting the importance of formal education in skill development. Years of experience also affect competences and skills, as shown by chi-square values of 68.288 (p=0.001) and 63.964 (p=0.002). These data show that practice and experience improve skills. Finally, maritime rank shows significant variations in core abilities (chi-square = 27.412; p=0.000) and technological skills (22.482; p=0.002).

In different groups, responsibilities and skill sets vary, resulting in diverse competencies and talents. These findings demonstrate that demographic and professional characteristics influence skill and competency development, underscoring the need for diverse training programs. This supports the idea that age and education affect competencies and skills, as older professionals have more experience and adaptability, which leads to higher proficiency (Popoola et al., 2024).

CONCLUSIONS

The respondents' profiles indicate that the majority of individuals in the maritime business are men with extensive experience. The average age of the respondents also suggests that they are seasoned professionals. Most of them have gone to graduate school and now work as Chief Engineers or Ship Captains. Many of them are also connected with training centers, indicating their desire for jobs abroad. Most of them have had training in regulatory compliance and cybersecurity. However, there are significant gaps in their knowledge of more modern technologies, which which highlights the importance of providing them with more specific training. Additionally, the competency exam shows that the person has average to above-average skills in digital and technical areas. Their technical and cybersecurity skills are average, but they excel at generating new ideas, adapting to new situations, leveraging technology, and adhering to rules. This indicates that they possess a solid foundation of skills necessary to address the challenges of the 4IR.

Moreover, the evaluation of technological skills among respondents reveals a range of average proficiency levels across various areas, including automation, robotics, digitalization, data analytics, and AI. Additionally, advanced navigation systems, remote sensing, and satellite communication are also at an average level. However, proficiency in VR and AR is lower, indicating room for improvement. Notably, the respondent demonstrates strong expertise in sustainable technologies, suggesting a solid understanding of this critical area.

Meanwhile, the Pearson correlation analysis reveals strong positive relationships between various competencies and technological skills. Core competencies are linked to technological skills in automation, digitalization, AI, advanced navigation, remote sensing, virtual reality, and sustainable technologies, indicating that improvements in these areas enhance technical competencies. Similarly, cybersecurity, innovation, adaptability, digital literacy, and regulatory compliance competencies positively impact technological skill development. Likewise, the Kruskal-

Wallis test shows that competencies and technological skills vary by age, education level, years of maritime experience, rank, and training attendance. Age affects all competencies and many technological skills, while higher education leads to stronger competencies. More experience generally improves skills, and differences exist among ranks, except in automation and robotics and sustainable technologies, which are consistent across levels. Attending relevant training positively influences technical competencies and regulatory knowledge, underscoring the importance of training for skill development.

Strategic Plan Framework

This strategic plan framework aims to position the maritime organization at the forefront of the maritime industry by fostering innovation and developing a highly skilled workforce in the context of the 4IR. By following and understanding this structured strategic plan framework, the maritime organization can effectively address current challenges and seize opportunities, ensuring sustainable growth and competitiveness in an evolving global maritime landscape. To address the challenges and opportunities of the 4IR, a strategic plan framework was developed to guide the initiative over the next decade, ensuring alignment with organizational goals.

Covering ten years, this Strategic Plan 2025-2030, dubbed as "Navigating Maritime Excellence: Building Core Competencies and Technological Skills for the Fourth Industrial Revolution (4IR)" serves as the blueprint towards the highest development and advancement as an important national player in knowledge creation and maritime industry innovation, and the development of the maritime workforce needed in the 4IR. This Strategic Plan also serves as a detailed road map for achieving remarkable growth and establishing the country as a leading maritime workforce in knowledge creation and innovation, particularly in the maritime sector. It emphasizes the importance of developing a skilled workforce that can adapt to the demands of the Fourth Industrial Revolution, where emerging technologies and digital solutions are transforming industry practices.

Pillar 1

Education and Training Programs include MHEIs Partnership, CPD, E-Learning, and Simulation-Based Learning.

Pillar 2

Industry Stakeholders Collaboration comprises Companies Engagement, Technology Providers Leverage, and Regulatory Alignment.

Pillar 3

Research and Development Initiatives involve Innovation Hubs, Industry-Research Collaboration, Funding, and Grants.

Pillar 4

Awareness and Advocacy encompasses workshops, conferences, Industry Publications, and Reports.

In the context of the 4IR, the maritime industry faces challenges such as automation, digitalization, and sustainability. This framework prioritizes enhancing core competencies such as data analytics, digital navigation, and cybersecurity to prepare the workforce for these changes. Not only does it provide a solid framework for strategic undertakings, but it also connects the training of staff, the use of technology, and the development of ideas to the broader industrial context. The

stable structure of the framework acts as a foundation upon which various strategic initiatives can be built. It ensures that efforts in workforce training, technological adoption, and innovation are cohesive and aligned with the broader vision for the industry. Ultimately, this framework not only supports immediate goals but also positions the maritime organization for long-term success in a dynamic and competitive maritime industry landscape.

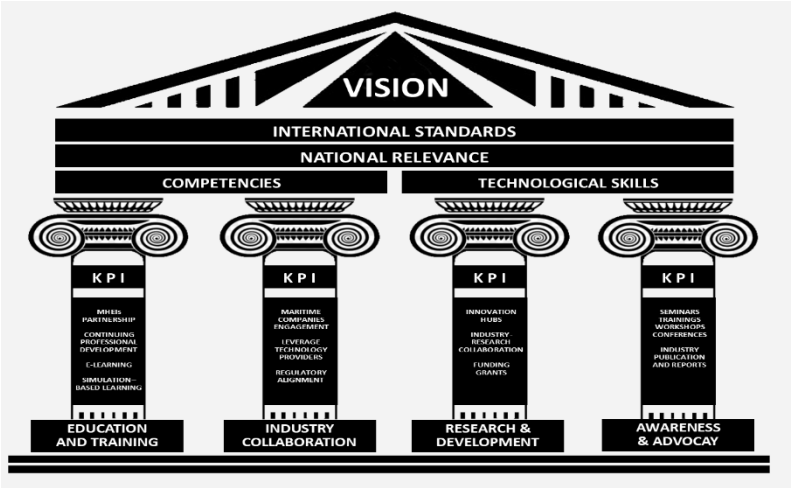

Figure 1. Strategic Plan Framework

LIMITATION & FURTHER RESEARCH

The study was limited to investigating the core competencies and technological skills of maritime professionals, particularly the Deck and Engine Officers, as current Maritime Education and Training (MET) academic programs may not adequately prepare them for the demands posed by the 4IR.

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