



Developing Maritime Management Curricula: Aligning Industry-Specific Needs with Sustainability and Emerging Technologies

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Abstract. *The maritime industry is rapidly evolving due to technological advancements and increased emphasis on sustainability. This research aims to develop a specialized maritime management curriculum that aligns with the needs of the port, shipping, and logistics sectors while incorporating emerging technologies and sustainability practices. Through qualitative research involving 5 maritime professionals, 5 lecturers, and 5 graduates, this study investigates the current gaps in maritime education and the essential competencies needed in modern maritime professions. Using descriptive analysis, the research provides insights into the integration of applied management studies, technical skills, and innovation into the curriculum. The study identifies key areas where existing curricula fall short, including the underrepresentation of technological and sustainability competencies. By examining the experiences of industry professionals and educational experts, a new curriculum framework is proposed, aiming to enhance graduate readiness for modern challenges. The curriculum effectiveness is evaluated using key performance indicators (KPIs), with a 9/10 score on alignment with industry needs. Comprehensive tables illustrate the scoring across various curriculum components, including technology integration, sustainability, and managerial skills. The findings suggest that the proposed curriculum model can significantly improve the employability of graduates, ensuring that they are equipped to meet the dynamic requirements of the maritime industry. Continuous curriculum development, with feedback from industry stakeholders, is recommended to maintain alignment with evolving industry needs.*

Keywords: *Maritime Management, Curriculum Development, Sustainability, Emerging Technologies, Vocational Education, Industry Alignment*

1. RESEARCH INTRODUCTION

The maritime sector is a cornerstone of global trade, with over 80% of global merchandise transported by sea. Ports, shipping, and logistics play critical roles in this complex ecosystem, requiring well-trained professionals to ensure efficient and sustainable operations. However, the industry is facing significant disruptions from technological advancements such as automation, artificial intelligence (AI), and smart port management, alongside growing pressures to adopt environmentally sustainable practices (Doumbia-Henry & Moorhouse, 2019). As a result, maritime professionals are expected to possess skills beyond traditional seamanship, including competencies in technology management, sustainability, and innovation.

Maritime vocational schools are tasked with preparing students to meet these evolving challenges. Yet, there is an increasing disconnect between the skills taught in these institutions and the demands of the modern maritime industry (Papachristos & Pallis, 2022). Current curricula often emphasize traditional technical skills, neglecting

critical areas such as applied management, emerging technologies, and sustainability (Kitada & Ölçer, 2018). This research aims to address this gap by developing a specialized maritime management curriculum that integrates industry-specific needs with emerging trends. Despite the growing need for specialized skills in the maritime industry, educational programs have been slow to adapt to these demands. Maritime professionals and employers frequently report that graduates are ill-equipped to handle the complexities of modern port, shipping, and logistics management (Shackleton & Collins, 2018). This is particularly true in the areas of technology adoption and sustainability, where graduates often lack the competencies needed to contribute effectively to their organizations. There is a clear need for a curriculum that aligns more closely with industry requirements, incorporating both technical and managerial skills that address current and future challenges.

Research Objectives

The objectives of this research are as follows:

1. To identify the key competencies required by maritime professionals in port, shipping, and logistics management, particularly concerning emerging technologies and sustainability practices.
2. To evaluate the current state of maritime vocational education and its alignment with industry demands, using qualitative insights from maritime professionals, lecturers, and graduates.
3. To develop a specialized maritime management curriculum that integrates applied management studies, emerging technologies, and sustainability practices.
4. To assess the effectiveness of the proposed curriculum using a comprehensive evaluation framework based on industry feedback.

Significance of the Study

This study is significant for both educational institutions and the maritime industry. For maritime vocational schools, the findings will provide a roadmap for developing curricula that better align with industry needs. The industry, in turn, will benefit from a more skilled and prepared workforce, capable of navigating the complexities of modern maritime operations (Nydam & Molenaar, 2020). Moreover, by incorporating sustainability practices and technological advancements into the curriculum, this research supports the industry's broader goals of environmental responsibility and operational efficiency (Poulsen & Sornn-Friese, 2015).

2. LITERATURE REVIEW

Several key trends have been identified in the literature regarding the development of maritime management curricula. First, technological innovation is driving change in maritime operations, with automation, AI, and smart technologies playing increasingly important roles (Chia & Ong, 2019). As noted by Buhmann and Bjerke (2020), educational institutions must integrate these technologies into their curricula to ensure graduates are prepared to work in this rapidly changing environment. Sustainability is another critical trend. The International Maritime Organization (IMO) has introduced stringent regulations aimed at reducing the environmental impact of maritime operations, particularly through the reduction of greenhouse gas emissions (IMO, 2020). However, few maritime educational programs emphasize the importance of sustainability, leaving graduates unprepared to meet these regulatory challenges (Kitada & Ölçer, 2018).

In addition to technical skills, there is growing recognition of the need for applied management studies in maritime education. As the industry becomes more complex, professionals must be proficient in areas such as leadership, innovation, and marketing (Jelassi & Martínez-López, 2020). Yet, these areas are often neglected in traditional curricula, contributing to the skills gap that exists between educational outcomes and industry needs (Papachristos & Pallis, 2022).

While there is a growing body of literature on the need for educational reform in maritime institutes, few studies have focused on developing specialized curricula that integrate emerging technologies, sustainability practices, and applied management studies. This research aims to fill this gap by proposing a comprehensive curriculum model that addresses the full spectrum of competencies required by modern maritime professionals. The hypothesis of this research is that a specialized maritime management curriculum that integrates emerging technologies, sustainability practices, and applied management studies will be more effective in preparing graduates for the modern maritime industry than traditional curricula. This hypothesis will be tested through qualitative interviews and descriptive analysis.

3. RESEARCH METHODS

This study adopts a qualitative research methodology, focusing on gathering in-depth insights from key stakeholders in the maritime industry. The qualitative approach is chosen because it allows for a nuanced understanding of the gaps in existing maritime

management curricula and provides rich, descriptive data from the perspectives of industry professionals, educators, and graduates (Creswell & Poth, 2018). Purposive sampling was employed to select participants who could provide valuable insights into the maritime industry's needs. The sample consisted of 15 participants: 5 maritime professionals, 5 lecturers, and 5 graduates, all of whom have direct experience with maritime management education and industry practices.

Maritime professionals included port managers, shipping officers, and logistics specialists, while lecturers were chosen based on their experience in vocational maritime education. Graduates were selected for their recent involvement in the maritime workforce. Data were collected through semi-structured interviews, which allowed participants to share their experiences and perspectives on the current state of maritime education and the skills required for success in the industry. The interviews were conducted over two months, either in person or via video conferencing, and each interview lasted approximately one hour. Interview questions focused on key competencies needed in the maritime industry, the integration of emerging technologies and sustainability practices, and suggestions for curriculum improvement.

The data collected from the interviews were analyzed using descriptive analysis. This involved coding the interview transcripts to identify common themes and patterns related to curriculum gaps and the competencies required by industry professionals. Themes were organized into categories such as "emerging technologies," "sustainability," "management competencies," and "curriculum alignment." Descriptive statistics were used to summarize the key findings, and tables were created to visually represent the scoring of the curriculum's effectiveness based on participant feedback. To ensure the validity and reliability of the research, triangulation was employed, using data from multiple sources (professionals, lecturers, and graduates) to corroborate the findings (Creswell & Poth, 2018). Additionally, member checking was conducted, allowing participants to review the interview transcripts and confirm the accuracy of the data.

4. RESULTS

Overview of Findings

The analysis of interview data from maritime professionals, lecturers, and graduates highlighted several key areas where the current maritime management curriculum is misaligned with industry needs. The findings are organized into three main categories: (1) **integration of emerging technologies**, (2) **sustainability practices**, and

(3) **applied management skills**, each of which was evaluated using key performance indicators (KPIs). The effectiveness of the proposed curriculum was scored by the participants, achieving an overall score of 9/10 in terms of its alignment with industry-specific needs and emerging trends.

Indicator 1: Integration of Emerging Technologies

Participants consistently emphasized the importance of incorporating emerging technologies such as AI, automation, and digital logistics management into the curriculum. Maritime professionals pointed to the growing use of autonomous ships and smart ports, while lecturers discussed the need for courses that focus on the technical and ethical implications of these technologies.

Indicator	Score (out of 10)	Qualitative Feedback
Integration of AI and Automation	9	"These skills are increasingly important in port and shipping operations" – Professional 2
Smart Port Management	9	"Students must understand how to operate and manage digitalized port systems" – Lecturer 3
Digital Logistics	8.5	"Logistics operations are becoming more tech-dependent, and graduates need these skills" – Graduate 5

Overall, the integration of emerging technologies was rated highly, with participants suggesting that maritime institutes should expand their curricula to cover new areas such as data analytics, cybersecurity, and blockchain in shipping management (Chia & Ong, 2019).

Indicator 2: Sustainability Practices

Sustainability was another key area where participants believed the curriculum could be improved. The IMO's regulations on reducing carbon emissions from shipping were cited as a critical driver for integrating sustainability into maritime education (IMO, 2020). Participants argued that sustainability courses should focus not only on regulatory compliance but also on innovative practices such as green logistics and energy-efficient port management (Kitada & Ölçer, 2018).

Indicator	Score (out of 10)	Qualitative Feedback
Emphasis on IMO Regulations	9.5	"Students need to understand the full impact of IMO regulations on maritime operations" – Professional 4
Green Logistics	8.5	"Sustainability must go beyond compliance and include innovative practices" – Graduate 2

Energy-Efficient Port Management	9	"There is an opportunity for students to learn how to optimize energy use in port operations" – Lecturer 1
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These results demonstrate a strong need for sustainability to be embedded more deeply into the maritime management curriculum. Participants stressed the importance of not just teaching regulatory frameworks but fostering an innovative mindset that looks for opportunities to enhance sustainability in the maritime sector.

Indicator 3: Applied Management Skills

The third key area identified in the study was the lack of applied management skills in existing curricula. Maritime professionals highlighted the importance of leadership, marketing, and innovation in port and shipping management. Participants indicated that graduates often lacked these skills, limiting their ability to take on managerial roles or innovate within their organizations.

Indicator	Score (out of 10)	Qualitative Feedback
Leadership and Team Management	9.5	"This is critical for graduates stepping into supervisory roles" – Professional 1
Marketing and Innovation	8	"Innovation is essential, but few maritime programs focus on marketing strategies" – Graduate 4
Strategic Planning	9	"Understanding the bigger picture is crucial for maritime managers" – Lecturer 2

The findings show that applied management skills must be emphasized in the curriculum. Participants suggested practical, case-based learning to develop these competencies, with particular focus on leadership and strategic planning (Jelassi & Martínez-López, 2020).

5. DISCUSSION

Emerging Technologies and Curriculum Development

The results indicate that the current maritime management curriculum is insufficiently aligned with the industry's technological advancements. The growing importance of AI, automation, and digital technologies in port and shipping management requires significant curriculum reform (Papachristos & Pallis, 2022). According to participants, the inclusion of digital tools such as smart port management systems is critical for preparing students for future roles in the industry. The overall score of 9/10 in this area suggests that the proposed curriculum effectively addresses the technological gap identified by both professionals and educators.

However, the integration of emerging technologies into the curriculum must be balanced with ethical considerations. As noted by Chia and Ong (2019), the rapid adoption of AI in shipping and port management could lead to unintended consequences such as job displacement and increased cyber risks. Maritime institutes should therefore ensure that their curricula include discussions on the ethical implications of these technologies, preparing students to navigate both the benefits and challenges associated with digital transformation.

Sustainability and Maritime Education

Sustainability emerged as a key theme throughout the study. The IMO's 2020 emissions regulations have prompted the maritime industry to rethink its operations, with green logistics and energy-efficient port management becoming increasingly important (IMO, 2020). The participants' emphasis on sustainability aligns with recent research, which highlights the need for maritime professionals to be well-versed in environmental regulations and sustainable business practices (Kitada & Ölçer, 2018).

While the proposed curriculum received a high score (9/10) in terms of its focus on sustainability, there remains room for improvement. Participants suggested that sustainability should not only be taught as a regulatory requirement but also as an opportunity for innovation. By teaching students to think critically about sustainability, maritime institutes can help foster a new generation of professionals who are capable of driving change within the industry (Wu & Wu, 2021).

Applied Management Skills: A Critical Gap

The results underscore the importance of applied management skills in modern maritime education. Leadership, marketing, and innovation were consistently cited as areas where graduates are underprepared (Shackleton & Collins, 2018). With the industry becoming increasingly competitive, maritime managers must be equipped with both technical and soft skills to drive organizational success (Jelassi & Martínez-López, 2020).

The proposed curriculum's emphasis on leadership and strategic planning was particularly well-received by participants, who rated these areas 9.5/10. However, marketing and innovation received a slightly lower score (8/10), indicating that these areas need further development. Participants suggested that case-based learning and internships could help bridge the gap between theoretical knowledge and practical application, enabling students to develop the managerial competencies needed in the maritime sector (Poulsen & Sornn-Friese, 2015).

6. CONCLUSION

This research highlights the need for curriculum reform in maritime vocational education, particularly in the fields of port, shipping, and logistics management. The integration of emerging technologies, sustainability practices, and applied management skills into the curriculum is essential for preparing graduates to meet the challenges of the modern maritime industry. The proposed curriculum model, which was evaluated using qualitative insights from maritime professionals, lecturers, and graduates, received high scores for its alignment with industry needs. The study's findings suggest that a more comprehensive approach to maritime education is necessary, one that balances technical skills with managerial competencies. The integration of AI, automation, and sustainability into the curriculum was well-received by participants, indicating that these areas should be prioritized in future curriculum development efforts. Additionally, the focus on leadership, marketing, and innovation will help ensure that graduates are equipped with the soft skills needed to succeed in managerial roles.

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