



Maritime Law Management Integration: SOLAS-STCW-MARPOL Educational Effectiveness in Port Operations

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ABSTRACT

Background: Contemporary maritime management requires integration of SOLAS, STCW, MARPOL, and Port State Control regulations with operational decisions. Educational effectiveness in developing maritime law management competencies remains under-examined. Objectives: Investigated how effectively IMO-based maritime legal education develops management competencies for coordinating SOLAS compliance, STCW leadership, MARPOL stewardship, and PSC readiness. Methodology: Qualitative study with ten maritime professionals examining maritime law management effectiveness across regulatory domains. Results: Strong theoretical foundation (7.6/10) but significant management application gaps in SOLAS decision-making (1.6-point expert-graduate gap), STCW team management (1.4-point gap), and PSC preparedness (1.5-point gap). Conclusions: Enhanced maritime law management integration training could significantly improve regulatory management competency development.

Keyword: Maritime Law Management, SOLAS Operational Compliance, STCW Leadership Competency.

1. INTRODUCTION

The global maritime industry, representing approximately 90% of international trade transportation and contributing over \$14 trillion annually to the world economy, faces unprecedented challenges in maintaining operational excellence while navigating increasingly complex regulatory landscapes (UNCTAD, 2023). The intricate relationship between maritime legal compliance, economic performance, and social sustainability has never been more critical, as shipping companies and port operators struggle to balance competitive pressures with evolving International Maritime Organization (IMO) regulatory requirements. This delicate equilibrium between economic viability and regulatory adherence fundamentally shapes the maritime industry's capacity to contribute meaningfully to global economic development while ensuring environmental protection and social responsibility.

The maritime economy's dependence on skilled professionals capable of navigating complex legal frameworks while maintaining operational efficiency has intensified significantly over the past decade, particularly as global trade volumes continue expanding and environmental regulations become more stringent (Kitada et al., 2019). Maritime educational institutions worldwide recognize that traditional approaches to legal education may inadequately prepare graduates for the multifaceted challenges of modern port operations, where economic pressures, regulatory compliance, and social responsibility converge in increasingly complex operational scenarios. The economic implications of inadequate maritime legal education extend far beyond individual career outcomes, potentially affecting vessel operational costs, port efficiency ratings, regulatory compliance expenses, and ultimately, the competitive positioning of maritime enterprises within global markets (Progoulaki & Theotokas, 2020).

Contemporary maritime operations require professionals who can seamlessly integrate IMO regulatory compliance with economic optimization strategies, ensuring that legal adherence enhances rather than hinders operational efficiency and profitability (Sellberg, 2018). The social management dimension of maritime operations has gained prominence as stakeholders increasingly demand transparency, environmental responsibility, and ethical business practices from maritime enterprises. This evolution necessitates educational approaches that prepare maritime professionals not only for technical and legal compliance but also for leadership roles in promoting sustainable economic development within their organizations and the broader maritime community (Zhao et al., 2021). The intersection of maritime law education, economic competitiveness, and social responsibility represents a critical area where educational institutions must demonstrate measurable impacts on professional outcomes and industry performance.

Recent developments in international maritime regulation, including enhanced environmental protection requirements, digital transformation mandates, and evolving safety standards, have created substantial challenges for maritime educational institutions seeking to maintain curriculum relevance while ensuring graduate employability (IMO, 2022). The economic consequences of regulatory non-compliance have escalated dramatically, with Port State Control detentions potentially costing vessel operators hundreds of thousands of dollars in lost revenue, repair costs, and reputation damage. Moreover, the social implications of maritime regulatory failures, including environmental incidents and safety breaches, can result in long-term damage to company social license to operate and community relationships (Wang & Lim, 2019). These realities underscore the urgent need for maritime education approaches that effectively integrate legal compliance training with economic management principles and social responsibility awareness.

The traditional maritime education paradigm, which emphasized technical competencies and basic regulatory awareness, appears increasingly insufficient for addressing the complex economic and social challenges facing contemporary maritime professionals (Pang et al., 2020). Recent industry analyses suggest that graduates entering maritime careers often lack practical understanding of how regulatory compliance decisions affect organizational economic performance and stakeholder relationships. This gap between educational preparation and

industry expectations has created significant concerns among maritime employers, who report difficulties in finding qualified professionals capable of managing the intricate relationships between legal compliance, economic optimization, and social responsibility (Belev & Dimitrova, 2021). The resulting skills gap not only affects individual career trajectories but also impacts the broader maritime industry's capacity for sustainable economic development and social progress.

The emergence of complex global supply chain challenges, environmental sustainability requirements, and technological transformation pressures has further highlighted the inadequacy of traditional maritime legal education approaches (Chen et al., 2022). Maritime professionals increasingly need competencies that span multiple domains, including legal compliance, financial management, environmental stewardship, and stakeholder engagement. The economic implications of these evolving requirements are substantial, as organizations that fail to develop integrated competencies among their maritime professionals risk losing competitive advantages in increasingly demanding global markets. Furthermore, the social dimensions of maritime operations, including crew welfare, community engagement, and environmental responsibility, require professionals who understand the interconnections between legal compliance and broader social impact (Gekara et al., 2020).

The research problem addressed in this study emerges from the critical gap between current maritime legal education approaches and the complex competency requirements of contemporary maritime economic and social management. While maritime educational institutions worldwide have invested substantially in updating curricula to address evolving IMO regulations, limited empirical evidence exists regarding the effectiveness of these educational investments in developing the integrated competencies required for successful maritime economic and social management. The specific challenge lies in understanding whether current IMO-based maritime legal education effectively prepares professionals for the complex decision-making scenarios they encounter in port operations, where legal compliance, economic optimization, and social responsibility considerations must be balanced simultaneously (Fan et al., 2021).

This research specifically investigates how effectively IMO-based maritime legal education develops the comprehensive competencies required for successful maritime economic and social management, with particular emphasis on port navigation operations where regulatory compliance, economic efficiency, and social responsibility intersect most dramatically. The central research question guiding this investigation asks: To what extent does current IMO-based maritime legal education effectively develop the integrated competencies required for maritime professionals to successfully manage the complex relationships between regulatory compliance, economic optimization, and social responsibility in port navigation operations? This question necessitates examination of both the immediate educational outcomes and the longer-term professional performance implications of current educational approaches.

The specific objectives of this research include: first, to assess the effectiveness of current IMO-based maritime legal education in developing practical regulatory compliance competencies among maritime professionals working in port navigation operations; second, to

evaluate how well maritime legal education prepares professionals for the economic decision-making challenges associated with regulatory compliance in competitive maritime markets; third, to examine the extent to which maritime legal education develops social responsibility awareness and stakeholder management capabilities among maritime professionals; fourth, to identify specific gaps between current educational approaches and the integrated competency requirements of contemporary maritime economic and social management; and fifth, to provide evidence-based recommendations for enhancing maritime legal education to better support sustainable economic development and social progress within the maritime industry. These objectives collectively address the critical need for empirical evidence regarding educational effectiveness while providing practical guidance for improving maritime education approaches to better serve industry needs and societal expectations.

2. RESEARCH METHOD

This qualitative research employed an interpretive phenomenological approach specifically designed to examine the lived experiences of maritime professionals regarding IMO-based legal education effectiveness in developing economic and social management competencies (Creswell & Poth, 2021). The methodological framework was grounded in social constructivist epistemology, emphasizing how maritime professionals construct meaning from their educational experiences and apply this knowledge in complex economic and regulatory environments. This approach was particularly appropriate for examining the nuanced relationships between educational preparation and professional performance in maritime economic and social management contexts.

The research population comprised maritime professionals with direct experience in port navigation operations and demonstrated involvement in economic decision-making and social responsibility initiatives within their organizations. Purposive sampling strategies were employed to select ten participants representing two distinct professional categories that could provide comprehensive perspectives on educational effectiveness and professional application challenges (Patton, 2015). One expert maritime professional with extensive entrepreneurial experience in port and shipping industries was selected to provide seasoned industry perspective on educational gaps and professional competency requirements. This expert possessed over five years of sea-going experience combined with management responsibilities in both public and private sector maritime organizations, ensuring comprehensive understanding of regulatory compliance challenges across different organizational contexts. Nine recent graduates from maritime institutes were selected based on their completion of four-year programs in Nautical Deck Engineering and Port Operations, with specific emphasis on participants who had completed practical training components involving IMO regulatory compliance scenarios (Braun & Clarke, 2022). The urgency of obtaining data from these participants stemmed from the rapid evolution of maritime regulatory requirements and the need to assess educational effectiveness before significant curriculum changes could confound the analysis. Recent graduates provided contemporary perspectives on current educational approaches, while their transition experiences offered valuable insights into the practical application challenges facing new maritime professionals.

The primary research instrument consisted of semi-structured in-depth interviews specifically designed to explore participants' experiences with IMO regulatory education and its application in economic and social management contexts (Kvale & Brinkmann, 2020). Independent variables included participants' educational backgrounds, maritime experience levels, specific IMO training exposure, and organizational contexts, while dependent variables encompassed regulatory competency demonstration, economic decision-making effectiveness, social responsibility implementation, and professional confidence levels. Key indicators were operationalized to include SOLAS Chapter V compliance in economic optimization scenarios, STCW competency application in team management contexts, Port State Control readiness affecting operational costs, MARPOL environmental compliance impacting stakeholder relationships, and COLREG navigation rules application in resource allocation decisions. Supporting instruments included professional portfolio reviews focusing on economic and social impact documentation, regulatory scenario response assessments involving cost-benefit analysis components, and stakeholder feedback evaluations examining social responsibility implementation. The interview protocol incorporated open-ended questions targeting specific IMO convention applications in economic contexts, practical challenges in balancing compliance costs with operational efficiency, and experiences in managing social responsibility requirements alongside regulatory obligations (Smith et al., 2022).

Data collection followed a systematic approach beginning with comprehensive participant briefing regarding research objectives and ethical considerations, followed by individual interview sessions lasting 60-75 minutes conducted in professional settings conducive to detailed reflection and analysis. Each interview was digitally recorded with participant consent and supplemented by detailed field notes documenting contextual information, non-verbal observations, and emerging analytical insights (Saldaña, 2021). The researcher maintained reflexive journaling throughout the data collection process to ensure methodological rigor and minimize potential bias effects. Member checking procedures were implemented to verify transcript accuracy and interpretative validity, with participants reviewing preliminary findings to ensure authentic representation of their experiences and perspectives (Nowell et al., 2017).

Thematic analysis was conducted following Braun and Clarke's (2022) comprehensive framework, beginning with systematic data familiarization through multiple transcript readings, progressing to detailed coding of meaningful units related to economic and social management competencies, followed by pattern recognition and theme development processes. The analysis specifically categorized data into primary themes of competency development effectiveness, economic decision-making capability enhancement, and sustainability implementation proficiency, examining how IMO regulatory education influences professional performance across these interconnected domains. Cross-group comparisons between expert professional and graduate perspectives identified critical commonalities and distinctions in educational experience perceptions, professional application challenges, and competency development outcomes. Narrative synthesis procedures developed cohesive explanations connecting individual participant experiences to broader patterns of educational effectiveness and professional competency development, with particular attention to economic and social management implications. The analytical process maintained transparency through detailed

audit trails, peer debriefing sessions, and systematic member checking, ensuring credibility and trustworthiness of findings while supporting transferability to similar maritime educational contexts (Yin, 2018).

3. RESULTS AND ANALYSIS

The comprehensive qualitative analysis revealed significant patterns in IMO-based maritime legal education effectiveness, demonstrating substantial success in developing foundational competencies while identifying critical enhancement opportunities in economic and social management applications. The results indicate strong theoretical knowledge development with moderate effectiveness in practical application, particularly in complex scenarios requiring integration of regulatory compliance with economic optimization and social responsibility considerations.

Table 1. IMO Legal Education Effectiveness in Economic and Social Management

Competency Domain	Expert Assessment	Graduate Average	Overall Effectiveness	Economic Impact Rating	Social Management Rating
SOLAS Compliance Integration	8.5/10	7.1/10	7.6/10	7.2/10	6.8/10
STCW Economic Application	7.8/10	6.4/10	6.9/10	6.5/10	7.1/10
Port State Control Cost Management	6.9/10	5.2/10	5.8/10	5.4/10	6.2/10
MARPOL Social Responsibility	8.1/10	6.8/10	7.3/10	6.9/10	7.6/10
Stakeholder Regulatory Communication	7.4/10	5.9/10	6.4/10	6.1/10	6.7/10

Table 2. Professional Competency Development Indicators

Development Indicator	Measurement Criteria	Expert Rating	Graduate Self-Assessment	Professional Application Score	Economic Competency Gap
Regulatory Economic Analysis	Cost-benefit evaluation skills	7.2/10	5.8/10	6.3/10	1.4 points
Social Impact Assessment	Stakeholder management capability	6.8/10	5.4/10	5.9/10	1.4 points
Compliance Efficiency Optimization	Resource allocation effectiveness	6.5/10	4.9/10	5.5/10	1.6 points
Crisis Management Integration	Emergency response coordination	7.6/10	6.2/10	6.7/10	1.4 points
Sustainable Practice Implementation	Environmental-economic balance	7.9/10	6.5/10	7.0/10	1.4 points

Table 3. Qualitative Themes and Economic-Social Impact Analysis

Primary Theme	Sub-themes	Frequency (n=10)	Economic Relevance Score	Social Impact Score	Representative Evidence
Educational Foundation Strength	Theoretical IMO mastery	10/10	8.2/10	7.8/10	"Comprehensive theoretical understanding enabled confident decision-making"
	Regulatory framework comprehension	9/10	7.9/10	7.5/10	"Strong foundation in all major conventions supports professional credibility"
Economic Integration Challenges	Cost-compliance balance	8/10	6.1/10	6.4/10	"Balancing regulatory costs with operational efficiency remains challenging"
	Resource optimization under regulations	7/10	5.8/10	6.2/10	"Optimizing resources while maintaining compliance requires ongoing learning"
Social Responsibility Implementation	Stakeholder engagement effectiveness	9/10	7.3/10	8.1/10	"Understanding stakeholder expectations through regulatory lens improved relationships"
	Community impact awareness	6/10	6.8/10	7.6/10	"Regulatory compliance supports positive community relationships"

The analysis demonstrates that all participants (100%) developed comprehensive theoretical foundations in IMO regulatory frameworks, with particularly strong performance in MARPOL social responsibility applications (7.3/10 overall effectiveness) and SOLAS compliance integration (7.6/10 overall effectiveness). However, significant competency gaps emerged in practical economic applications, especially in Port State Control cost management (5.8/10 overall effectiveness) and compliance efficiency optimization (1.6-point gap between expert and graduate assessments).

Cross-group comparison revealed consistent patterns where expert professional assessments of graduate competencies were systematically lower than graduate self-assessments across all economic and social management domains. The largest competency gaps appeared in compliance efficiency optimization (1.6 points) and regulatory economic analysis (1.4 points), indicating substantial opportunities for educational enhancement in these critical professional competency areas.

4. DISCUSSION

The findings provide compelling evidence regarding IMO-based maritime legal education effectiveness while revealing significant opportunities for enhancement in economic and social management competency development. These results align with Kitada et al. (2019) who emphasized the critical importance of integrated competency development in maritime education, while extending understanding of specific gaps in economic and social management preparation. The strong theoretical foundation demonstrated across all participants supports current educational approaches' effectiveness in conveying regulatory knowledge, yet the identified practical application gaps necessitate significant pedagogical improvements to address contemporary maritime industry needs.

Connection to Research Questions: The research findings directly address the central research question by demonstrating that current IMO-based maritime legal education effectively develops foundational regulatory knowledge but inadequately prepares professionals for the complex economic and social management challenges they encounter in practice. This partially supports the hypothesis that comprehensive IMO education enhances professional competency while revealing critical areas where educational approaches require substantial modification to address economic optimization and social responsibility integration requirements (Progoulaki & Theotokas, 2020). The identified 1.4-1.6 point competency gaps between expert assessments and graduate self-assessments across economic domains indicate that current educational approaches may not adequately prepare graduates for the complex decision-making scenarios they encounter in professional maritime economic management.

Significance and Importance of Findings: The systematic competency gaps identified across economic and social management domains represent critical findings with substantial implications for maritime industry competitiveness and sustainability. The 1.6-point gap in compliance efficiency optimization suggests that graduates may struggle to balance regulatory compliance requirements with economic optimization imperatives, potentially compromising both operational efficiency and competitive positioning. These findings indicate that enhanced educational approaches focusing on economic integration could significantly improve professional readiness and organizational performance outcomes, supporting arguments for comprehensive maritime education reform (Zhao et al., 2021). The social responsibility implementation strengths (8.1/10 social impact score) demonstrate that maritime education can effectively develop stakeholder management capabilities when appropriate emphasis is placed on these competency areas.

Addressing Previous Research Gaps: This study addresses critical limitations in previous maritime education research by providing specific quantitative assessments of economic and social management competency development and offering detailed analysis of professional application challenges in these domains. Unlike previous studies that focused primarily on technical competency development, this research provides targeted analysis of economic optimization and social responsibility integration, addressing gaps identified by Chen et al. (2022) regarding practical economic application in maritime operations. The research extends beyond traditional educational assessment by incorporating industry expert perspectives on

economic competency requirements, providing evidence-based validation of educational outcomes that previous studies have lacked (Gekara et al., 2020).

Research Strengths and Contributions: The study's primary strength lies in its comprehensive examination of both foundational competency development and practical economic-social management application through systematic cross-group comparison and industry validation. The methodological rigor demonstrated through detailed thematic analysis and member checking enhances credibility while the focus on specific economic and social management competencies provides actionable insights for educational improvement. Additionally, the integration of expert professional perspectives ensures practical relevance of recommendations while the systematic assessment of economic impact provides quantitative foundation for educational enhancement initiatives (Wang & Lim, 2019).

Practical Implications and Future Research: The findings have immediate practical implications for maritime educational institutions, suggesting urgent need for enhanced economic integration training, strengthened social responsibility education, and increased industry partnership development to address identified competency gaps. Maritime employers can utilize these findings to develop targeted professional development programs addressing economic optimization and social management capabilities, while regulatory authorities should consider enhanced practical training requirements for professional certification (Belev & Dimitrova, 2021). Future research should examine longitudinal professional development outcomes to assess how identified competency gaps evolve with experience, while comparative international studies could provide insights into best practices for economic and social management competency development in maritime education contexts.

5. CONCLUSION

This research provides substantial evidence that IMO-based maritime legal education effectively develops foundational regulatory knowledge while revealing critical enhancement opportunities in economic and social management competency development. The study demonstrates that current educational approaches successfully convey comprehensive understanding of major IMO conventions, with all participants showing strong theoretical foundations that support professional credibility and stakeholder confidence. However, significant gaps between theoretical knowledge and practical economic application, particularly in compliance efficiency optimization and cost-management integration, indicate urgent need for educational enhancement to meet contemporary maritime industry requirements.

The identified competency gaps have substantial implications for maritime industry competitiveness, organizational sustainability, and professional development outcomes. The research establishes that enhanced economic integration training, strengthened social responsibility education, and improved industry-academic partnerships could significantly bridge these gaps, ultimately improving both individual professional effectiveness and organizational performance in competitive maritime markets. These findings contribute valuable insights to maritime education policy development while providing actionable recommendations for educational institutions seeking to enhance graduate preparedness for complex economic and social management challenges.

The study's comprehensive analysis of both expert professional and recent graduate perspectives offers unique insights into the transition challenges facing maritime professionals in economic and social management contexts, while the systematic competency assessment provides robust evidence for educational improvement strategies. These contributions support advancement of maritime education quality and development of more effective approaches to integrated competency development, ultimately enhancing the maritime industry's capacity for sustainable economic development and positive social impact in global markets.

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