

Strengthening the Philippine Coast Guard Vessel Safety Enforcement Inspection capacity development program

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Abstract

Aim: Effective maritime safety enforcement requires competent Vessel Safety Enforcement Inspection (VSEI) personnel capable of conducting consistent and technically sound vessel inspections. This study assessed the competency of Philippine Coast Guard VSEI inspectors and instructors, evaluated the effectiveness of the existing VSEI Training Course, identified operational challenges and best practices, and developed a strengthened competency-based capacity development program to enhance maritime safety enforcement and organizational capability.

Methodology: An explanatory sequential mixed methods research design was employed. Quantitative data were collected from 94 VSEI inspectors and seven instructors assigned to Philippine Coast Guard Region 1 using a validated survey questionnaire, while qualitative data were gathered through open-ended responses to further explain the quantitative findings. Frequency distribution and weighted mean were used for quantitative analysis, whereas thematic analysis was employed to analyze qualitative data.

Results: The findings revealed that VSEI inspectors demonstrated a generally competent level of performance, while instructors consistently exhibited high competency across all assessed domains. The existing VSEI Training Course was evaluated as highly effective in terms of course content, learning activities, instructional materials, and assessment strategies. However, limited practical vessel exposure, insufficient field immersion opportunities, logistical constraints, and training duration were identified as areas requiring improvement. Scenario-based assessment significantly enhanced technical competence, decision-making, operational readiness, and problem-solving skills. Based on the integrated findings, a Competency-Based Career Progression Framework consisting of Apprentice, Junior, and Senior VSEI Inspector levels was developed to strengthen inspector competency, professional growth, and organizational capability.

Conclusion: Strengthening competency-based training, expanding practical inspection experiences, and institutionalizing a structured career progression framework may significantly improve the effectiveness of Vessel Safety Enforcement Inspection operations. The proposed capacity development program provides a systems-oriented engineering framework that enhances inspection quality, strengthens organizational capability, supports regulatory compliance, and contributes to continuous improvement in maritime safety enforcement within the Philippine Coast Guard.

Keywords: Vessel Safety Enforcement Inspection, Philippine Coast Guard, maritime safety, competency assessment, capacity development

INTRODUCTION

Maritime transportation remains one of the most critical components of global economic development, facilitating approximately ninety percent of international trade while ensuring the efficient movement of people, goods, and strategic resources across national and international waters. As maritime commerce continues to expand, governments are increasingly challenged to strengthen vessel safety systems, regulatory compliance, and inspection mechanisms to reduce operational risks, protect marine ecosystems, and safeguard human life (Mba, 2025). International maritime organizations continue to emphasize that effective vessel inspection systems are essential components of maritime governance because they directly influence navigational safety, environmental protection, and



compliance with international maritime conventions (Chuah et al., 2022). Alongside these developments, the maritime sector has experienced rapid digital transformation characterized by the adoption of digital inspection systems, electronic inspection management platforms, and data-driven decision-support mechanisms that improve inspection consistency, operational efficiency, and regulatory oversight. These technological advances reflect broader Industry 4.0 initiatives that promote digitalization, cyber-physical operational environments, and intelligent management systems for maritime safety enforcement.

The Philippines, an archipelagic nation composed of more than 7,600 islands, depends heavily on maritime transportation for economic development, national integration, tourism, fisheries, inter-island commerce, and national security (Azanza et al., 2022). Thousands of domestic vessels operate daily within Philippine waters, making vessel safety enforcement a critical national responsibility. As maritime traffic increases, the likelihood of vessel-related incidents, regulatory violations, and operational deficiencies also grows, requiring stronger inspection systems and competent maritime enforcement personnel capable of ensuring compliance with established safety regulations. In response to global digital transformation, maritime administrations are likewise strengthening smart maritime governance through the integration of electronic inspection management systems, digital documentation, and technology-enabled regulatory processes that support more responsive and transparent vessel safety oversight.

The Philippine Coast Guard (PCG), mandated under Republic Act No. 9993, serves as the country's primary maritime safety, maritime security, and marine environmental protection agency. Among its major responsibilities is the implementation of the Vessel Safety Enforcement Inspection (VSEI) Program, which ensures that domestic vessels comply with applicable maritime laws, technical standards, operational requirements, and international safety conventions before being allowed to operate. Effective implementation of the VSEI Program depends largely on the technical competence, inspection capability, and operational readiness of VSEI inspectors and instructors responsible for enforcing these standards.

Recent developments in maritime engineering and safety management have shifted organizational priorities toward competency-based inspection systems, continuous professional development, risk-based inspection methodologies, and evidence-driven capacity-building programs. Maritime administrations worldwide have increasingly adopted structured competency frameworks that integrate technical knowledge, practical inspection skills, operational decision-making, leadership development, and continuous performance evaluation. These developments have also encouraged the adoption of digital competency management approaches that support continuous learning, electronic competency monitoring, and workforce development aligned with modern maritime operational requirements. Moreover, advances in smart maritime technologies, including AI-assisted inspection support, predictive analytics, and data-driven inspection planning, are increasingly influencing how maritime organizations strengthen inspection quality and operational readiness. Such approaches recognize that maritime safety is influenced not only by regulatory compliance but also by the technical capability of personnel responsible for implementing inspection systems.

Despite continuous improvements in maritime safety regulations, several operational challenges continue to affect the effectiveness of vessel inspection programs. Limited opportunities for practical vessel inspections, insufficient field immersion, resource constraints, logistical limitations, and varying levels of inspector experience continue to influence inspection consistency and operational effectiveness. Existing training programs often provide adequate theoretical instruction but may not sufficiently address real-world operational scenarios requiring rapid decision-making, technical judgment, and multidisciplinary inspection competencies. As maritime organizations continue transitioning toward digitally enabled and data-driven inspection environments, workforce development programs must likewise prepare inspectors to operate effectively within technology-supported inspection systems while maintaining high standards of regulatory compliance and operational performance. These conditions highlight the need for strengthened capacity development programs that systematically integrate technical training, competency assessment, operational experience, and career progression.

Recent studies in maritime safety management have focused on inspection systems, competency development, human factors, maritime risk management, and regulatory compliance. However, relatively limited research has examined the comprehensive evaluation of Vessel Safety Enforcement Inspection competency, training effectiveness, scenario-based assessment, operational challenges, and career progression within the Philippine Coast Guard. Existing literature has generally examined individual components of maritime safety systems rather than providing an integrated evaluation of inspector competency, instructional effectiveness, operational readiness, and organizational capacity development within the context of ongoing digital transformation in maritime safety management.

Addressing this gap is essential because inspection quality directly affects maritime safety outcomes, regulatory compliance, and organizational performance. Strengthening inspector competency contributes not only to improved vessel inspection practices but also to more effective implementation of maritime safety policies, enhanced



operational efficiency, reduced inspection variability, and increased public confidence in maritime governance. Furthermore, strengthening competency development supports the preparation of a digitally capable inspection workforce that can effectively adapt to evolving Industry 4.0 technologies and smart maritime governance initiatives.

Accordingly, this study evaluated the competence of Philippine Coast Guard Vessel Safety Enforcement Inspection inspectors and instructors, assessed the effectiveness of the existing VSEI Training Course, identified operational challenges and best practices encountered during training implementation, and developed a Competency-Based Capacity Development Program designed to strengthen inspection capability, professional competency, and organizational effectiveness. The proposed framework contributes to maritime engineering practice by providing a structured operational model for competency development that supports continuous improvement in vessel safety enforcement, maritime regulatory compliance, organizational capability enhancement, and workforce readiness for digitally enabled and technology-driven maritime inspection systems.

Review of Related Studies

Recent developments in maritime engineering between 2021 and 2026 have increasingly emphasized competency-based inspection systems, digital transformation, risk-informed vessel safety management, and continuous professional development as essential elements of effective maritime governance. Advances in maritime inspection methodologies have focused on improving inspection consistency, technical competency, operational readiness, and organizational resilience through structured training systems and evidence-based capacity development programs (Baig et al., 2025).

International maritime literature has consistently identified competent inspectors as one of the most critical determinants of effective maritime safety enforcement (Sheriff et al., 2025). Studies have demonstrated that inspector competency directly influences the quality of vessel inspections, regulatory compliance, accident prevention, and maritime operational safety. Competency encompasses technical knowledge of maritime regulations, vessel systems, inspection procedures, documentation practices, emergency preparedness, communication skills, and professional judgment necessary for effective enforcement activities.

Another major trend in recent maritime research involves competency-based education and training (Yu et al., 2025). Modern maritime organizations increasingly utilize competency frameworks that integrate classroom instruction with practical simulation, onboard inspection experience, and performance-based assessments. Scenario-based learning has become widely recognized as an effective instructional approach because it exposes inspectors to realistic operational situations requiring technical analysis, decision-making, and problem-solving under actual working conditions.

Research has likewise emphasized that effective maritime inspection programs require continuous organizational learning rather than one-time certification (Koritarov & Dimitrakiev, 2025). Career progression models incorporating competency milestones, periodic reassessment, mentoring systems, and advanced specialization have been shown to improve workforce capability while supporting institutional knowledge retention and sustainable organizational development.

Operational studies have further identified several challenges affecting inspection effectiveness, including limited field exposure, resource constraints, insufficient access to actual vessels during training, scheduling limitations, and inconsistencies between theoretical instruction and operational practice. These challenges often reduce opportunities for inspectors to develop practical competencies essential for effective vessel inspections, highlighting the importance of integrating simulation, field immersion, and structured competency assessment within maritime training programs.

Collectively, recent literature demonstrates that successful maritime safety systems depend not only on regulatory frameworks but also on systematic investment in inspector competency, continuous professional development, structured assessment systems, and organizational learning mechanisms. These developments provide a strong technical foundation for strengthening Vessel Safety Enforcement Inspection capacity within the Philippine Coast Guard.

Synthesis and Research Gap

Contemporary maritime safety research demonstrates substantial advances in competency-based training, inspection methodologies, simulation-based learning, and maritime regulatory compliance. Existing studies have contributed valuable knowledge regarding maritime safety management, risk assessment, inspection procedures, and professional development of maritime personnel. Nevertheless, most investigations have examined these components



independently rather than evaluating them as integrated elements of a comprehensive vessel inspection capacity development system.

Specifically, limited empirical research has simultaneously examined inspector competency, instructor competency, training effectiveness, scenario-based assessment, operational constraints, and competency-based career progression within the context of the Philippine Coast Guard Vessel Safety Enforcement Inspection Program. Moreover, few studies have translated competency assessment findings into an operational capacity development framework that directly supports organizational improvement and sustainable maritime safety enforcement.

To address these gaps, the present study integrated quantitative competency assessment and qualitative operational analysis to evaluate the effectiveness of the existing VSEI Training Course and develop a Competency-Based Career Progression Framework for Vessel Safety Enforcement Inspection personnel. The proposed framework extends current maritime engineering practice by providing a structured operational model that strengthens inspector competency, enhances training effectiveness, supports organizational capability development, and contributes to continuous improvement in maritime safety enforcement.

Theoretical Framework

The study was anchored on four complementary frameworks that collectively explain competency development, training evaluation, organizational capability enhancement, and continuous improvement in maritime safety enforcement. These theories guided the assessment of Vessel Safety Enforcement Inspection (VSEI) inspectors and instructors and provided the foundation for the proposed Competency-Based Capacity Development Program.

Human Capital Theory

The Human Capital Theory proposed by Becker explains that investments in education, training, and professional development increase workforce productivity and organizational performance (Ositadimma et al., 2025). Within maritime organizations, inspector competence represents a strategic organizational asset that directly influences the quality of vessel inspections, regulatory compliance, operational safety, and public confidence in maritime governance.

The theory supported the premise that continuous investment in inspector education, practical training, competency assessment, and career development strengthens the Philippine Coast Guard's capability to perform Vessel Safety Enforcement Inspection functions more effectively.

Kirkpatrick's Four-Level Training Evaluation Model

The Kirkpatrick Model served as the principal framework for evaluating the effectiveness of the existing VSEI Training Course. The model examines training through four progressively connected dimensions (Alsalamah & Callinan, 2022):

- participants' reaction toward the training;
- knowledge and skills acquired during instruction;
- behavioral changes demonstrated during actual inspection activities; and
- organizational outcomes resulting from improved inspection competency.

Using this framework enabled the study to evaluate whether the existing training program adequately developed operational competencies required for effective maritime inspection.

Lewin's Three-Stage Change Model

The proposed Capacity Development Program was likewise anchored on Lewin's organizational change model consisting of:

- Unfreezing
- Changing
- Refreezing

This framework recognizes that organizational improvement requires systematic preparation, implementation of new competency development strategies, and institutionalization of improved inspection practices (Ellis, 2023). The model provided guidance in designing sustainable improvements within the Philippine Coast Guard training system.

Systems Engineering Framework

From an engineering perspective, the study adopted the Systems Engineering Framework because Vessel Safety Enforcement Inspection functions as an integrated operational system composed of interconnected elements including (Buede & Miller, 2024):

- inspectors;
- instructors;
- training programs;
- operational procedures;
- assessment mechanisms;
- regulatory standards; and
- organizational support systems.

Rather than examining these components independently, the Systems Engineering Framework considers the interactions among all subsystems that collectively determine inspection effectiveness.

The framework guided the development of an integrated competency development model that strengthens not only individual inspector capability but also overall organizational performance.

Conceptual Framework

The conceptual framework illustrates the relationship among inspector competency, instructor competency, training effectiveness, operational challenges, and the proposed Competency-Based Capacity Development Program. The framework follows an Input-Process-Output (IPO) systems model commonly employed in engineering and organizational system development.

Input

The inputs consisted of:

- demographic profile of inspectors and instructors;
- competency of VSEI inspectors;
- competency of VSEI instructors;
- effectiveness of the existing VSEI Training Course;
- effectiveness of scenario-based assessment;
- operational challenges encountered during training implementation;
- identified best practices.

Process

The process involved:

- administration of validated survey instruments;
- quantitative competency assessment;
- qualitative data collection through open-ended responses;
- statistical analysis using frequency distribution and weighted mean;
- thematic analysis of qualitative responses;
- integration of quantitative and qualitative findings;
- development of the proposed Capacity Development Program.

Output

The output of the study was the development of a **Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program** incorporating a structured career progression framework consisting of:

- Apprentice VSEI Inspector
- Junior VSEI Inspector
- Senior VSEI Inspector

The proposed framework integrates competency standards, practical inspection experience, continuous assessment, mentoring, leadership development, and periodic professional upgrading to strengthen maritime safety enforcement capability.

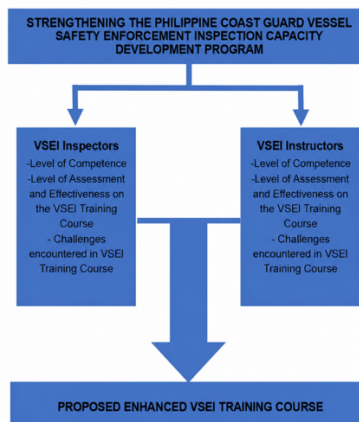


Figure 1. Conceptual Diagram

Statement of the Problem

The Philippine Coast Guard's Vessel Safety Enforcement Inspection (VSEI) Program plays a vital role in ensuring maritime safety by verifying that domestic vessels comply with national laws, technical standards, and international maritime safety requirements. As maritime operations continue to increase in complexity, the effectiveness of vessel safety enforcement depends largely on the competency of inspectors, the quality of training programs, and the organization's capacity to continuously develop its inspection workforce. However, operational challenges such as limited practical vessel exposure, resource constraints, varying competency levels, and the need for structured career development may affect the consistency and effectiveness of inspection activities. Despite the importance of competency-based inspection systems, limited studies have comprehensively evaluated inspector competency, training effectiveness, operational challenges, and career progression within the Philippine Coast Guard's VSEI Program. Addressing these concerns is essential to strengthen organizational capability, improve inspection quality, enhance maritime regulatory compliance, and support continuous improvement in maritime safety enforcement. Accordingly, this study assessed the competency of VSEI inspectors and instructors, evaluated the effectiveness of the existing VSEI Training Course, examined operational challenges, and developed a strengthened Competency-Based Capacity Development Program for the Philippine Coast Guard.

General Objective

To develop a strengthened Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program by evaluating inspector competency, training effectiveness, operational challenges, and organizational capability within the Philippine Coast Guard.

Specific Objectives

1. To determine the competency levels of Vessel Safety Enforcement Inspection inspectors and instructors.
2. To evaluate the effectiveness of the existing Vessel Safety Enforcement Inspection Training Course in terms of:
 - course topics;
 - learning activities;
 - instructional materials;
 - assessment methods; and
 - training duration.
3. To assess the perceived effectiveness of scenario-based assessment in developing inspector competency.
4. To identify the operational challenges and best practices encountered during the implementation of the Vessel Safety Enforcement Inspection Training Course.
5. To develop a strengthened Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program based on the findings of the study.

Research Questions

This study sought to answer the following questions:

1. What are the competency levels of Vessel Safety Enforcement Inspection inspectors and instructors?
2. How effective is the existing Vessel Safety Enforcement Inspection Training Course in terms of:
 - a. course topics;
 - b. learning activities;
 - c. instructional materials;
 - d. assessment methods; and
 - e. training duration?
3. What is the perceived effectiveness of scenario-based assessment in developing Vessel Safety Enforcement Inspection competencies?
4. What operational challenges and best practices are encountered during the implementation of the Vessel Safety Enforcement Inspection Training Course?
5. Based on the findings of the study, what Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program may be developed?

METHODOLOGY

Research Design

The study employed an explanatory sequential mixed methods research design. Quantitative data were initially collected to determine the competency levels of Vessel Safety Enforcement Inspection (VSEI) inspectors and instructors and to evaluate the effectiveness of the existing VSEI Training Course. These quantitative findings were subsequently explained through qualitative data gathered from participants regarding operational challenges, best practices, and recommendations for improving the training program.

The explanatory sequential approach was considered appropriate because it allowed numerical competency measurements to be complemented by detailed participant experiences, thereby providing a more comprehensive understanding of inspection capability and training effectiveness. The sequential integration of quantitative and qualitative findings also supported the development of the proposed Competency-Based Capacity Development Program based on organizational systems engineering principles.

Operational System Components

The operational system evaluated in this study consisted of the Vessel Safety Enforcement Inspection (VSEI) organizational framework of the Philippine Coast Guard. The system included VSEI inspectors, VSEI instructors, competency domains, the existing VSEI Training Course, scenario-based assessment activities, operational procedures, and the proposed competency-based career progression framework. These interconnected components were treated as an integrated organizational system for evaluating inspection capability and developing an improved Capacity Development Program based on systems engineering principles.

Participants of the Study

The study involved a total of 101 respondents from Philippine Coast Guard Region 1, composed of:

- 94 Vessel Safety Enforcement Inspection inspectors
- 7 Vessel Safety Enforcement Inspection instructors

Participants were selected through purposive sampling because they possessed direct experience in Vessel Safety Enforcement Inspection operations and training implementation. Their professional involvement enabled them to provide reliable assessments regarding competency, operational effectiveness, and training implementation.

Research Instrument

Data were collected using a researcher-developed competency assessment instrument that was subjected to expert validation prior to implementation. The primary operational assessment tool consisted of a structured competency assessment questionnaire supported by operational evaluation forms and qualitative response instruments.

The instrument consisted of five major sections:

1. competency assessment of VSEI inspectors;
2. competency assessment of VSEI instructors;
3. evaluation of the VSEI Training Course;



4. effectiveness of scenario-based assessment;
5. operational challenges and best practices.

The questionnaire utilized a five-point Likert scale to determine perceived competency and training effectiveness, while open-ended questions generated qualitative information regarding operational experiences, implementation challenges, best practices, and recommendations for program improvement.

Instrument Validation

The competency assessment instrument underwent face and content validation conducted by experts in maritime education, maritime safety, and research methodology.

Recommendations from the validators were incorporated prior to pilot implementation to improve clarity, content relevance, construct validity, and overall usability of the instrument.

Data Collection Procedure

Approval to conduct the study was obtained from the appropriate Philippine Coast Guard authorities before data collection commenced.

The research procedure consisted of the following steps:

1. securing administrative approval;
2. coordinating with participating Coast Guard units;
3. explaining the objectives of the study;
4. obtaining informed consent;
5. administering the validated competency assessment instrument;
6. collecting completed questionnaires;
7. organizing and encoding quantitative data; and
8. consolidating qualitative responses.

Strict confidentiality was maintained throughout the entire data collection process.

Data Analysis

Quantitative data were analyzed using descriptive statistical techniques.

Specifically,

- frequency distribution was used to describe the demographic profile of the respondents;
- weighted mean was used to determine competency levels and training effectiveness; and
- composite mean was computed to evaluate the overall effectiveness of the existing VSEI Training Course.

Qualitative responses were analyzed using thematic analysis involving:

- familiarization with the responses;
- coding;
- categorization;
- identification of recurring themes; and
- interpretation of findings.

The integration of quantitative and qualitative findings provided comprehensive evidence for developing the proposed Competency-Based Capacity Development Program.

Ethical Considerations

The study strictly complied with established ethical standards governing research involving human participants. Participation was entirely voluntary.

Each participant received a clear explanation regarding the objectives of the study, research procedures, expected duration of participation, confidentiality safeguards, and the right to withdraw from the study at any stage without penalty.

Individual responses remained anonymous, and all collected information was used exclusively for academic and research purposes. No identifying personal information was disclosed in any report or publication resulting from the study.

Administrative permission was likewise secured from the Philippine Coast Guard before implementation of the research to ensure compliance with institutional research policies and operational protocols.



Engineering and Maritime Innovation Contribution

This study extends beyond evaluating personnel competence by proposing an integrated operational framework for strengthening the Vessel Safety Enforcement Inspection system of the Philippine Coast Guard. The proposed Competency-Based Capacity Development Program integrates competency standards, structured career progression, practical field immersion, scenario-based assessment, continuous professional development, and organizational performance improvement into a unified systems engineering approach. By treating competency development, training implementation, operational procedures, and career progression as interconnected components of an integrated organizational system, the proposed framework provides a replicable engineering-oriented model that may enhance inspection quality, organizational capability, operational efficiency, and maritime regulatory compliance across maritime enforcement agencies.

RESULTS AND DISCUSSION

Competency of Vessel Safety Enforcement Inspection (VSEI) Inspectors and Instructors

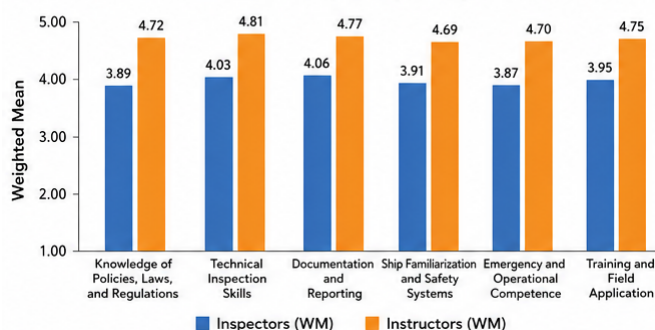
The first objective of the study was to determine the competency levels of Philippine Coast Guard Vessel Safety Enforcement Inspection (VSEI) inspectors and instructors across six core competency domains. These included: (1) knowledge of maritime policies, laws, and regulations; (2) technical inspection skills; (3) inspection documentation and reporting; (4) ship familiarization and safety systems; (5) emergency and operational competence; and (6) training and field application. The findings revealed that both inspectors and instructors possessed competency levels sufficient to perform Vessel Safety Enforcement Inspection responsibilities, although notable differences existed between the two groups.

Table 1

Overall Competency of VSEI Personnel

Competency Domain	Inspectors (WM)	Interpretation	Instructors (WM)	Interpretation
Knowledge of Policies, Laws, and Regulations	3.89	Competent	4.72	Highly Competent
Technical Inspection Skills	4.03	Competent	4.81	Highly Competent
Documentation and Reporting	4.06	Competent	4.77	Highly Competent
Ship Familiarization and Safety Systems	3.91	Competent	4.69	Highly Competent
Emergency and Operational Competence	3.87	Competent	4.70	Highly Competent
Training and Field Application	3.95	Competent	4.75	Highly Competent
Composite Mean	3.95	Competent	4.74	Highly Competent

Figure 2. Bar Chart Comparing Inspector and Instructor Competency Ratings





The findings demonstrated that instructors consistently obtained higher competency ratings than inspectors across all competency dimensions. This result was expected because instructors generally possess longer operational experience, broader exposure to maritime regulations, and greater involvement in training implementation. Their expertise contributes significantly to maintaining instructional quality and ensuring that inspectors acquire competencies aligned with current maritime safety standards.

Among inspectors, the highest competency ratings were observed in technical inspection skills and inspection documentation. These competencies are regularly exercised during actual vessel inspections and therefore become highly developed through repeated operational practice. Accurate inspection documentation is particularly essential because inspection reports constitute official regulatory records used to determine vessel compliance, recommend corrective actions, and support enforcement decisions.

Competency in ship familiarization, emergency operations, and field application also received favorable evaluations, indicating that inspectors were capable of conducting inspections under normal operating conditions. Nevertheless, respondents acknowledged that certain operational situations involving complex vessel systems, emergency scenarios, and specialized inspections require additional practical experience and continuous professional development.

These findings reinforce the importance of competency-based maritime training systems that combine technical knowledge with repeated field exposure (Uddin & Siska, 2026). Maritime inspection effectiveness depends not only on theoretical understanding of regulations but also on inspectors' ability to apply technical judgment consistently during actual vessel inspections (Boko et al., 2025). From an engineering systems perspective, the competency levels demonstrated by both inspectors and instructors indicate that the Vessel Safety Enforcement Inspection (VSEI) Program possesses a technically capable inspection workforce that supports reliable implementation of maritime safety regulations. Higher competency levels contribute to improved inspection reliability, reduced variability in inspection outcomes, enhanced operational efficiency, and more consistent regulatory enforcement. The higher competency demonstrated by instructors likewise strengthens organizational capability because experienced personnel serve as mentors and technical resource persons who facilitate continuous knowledge transfer and competency development within the Philippine Coast Guard inspection system.

Assessment of the Effectiveness of the Existing VSEI Training Course

The second objective examined the effectiveness of the existing Vessel Safety Enforcement Inspection Training Course.

Five major components were evaluated:

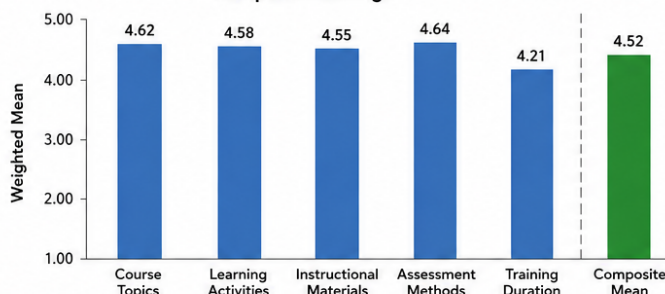
- course topics;
- learning activities;
- instructional materials;
- assessment methods; and
- training duration.

Table 2

Assessment of the Existing VSEI Training Course

Training Component	Weighted Mean	Interpretation
Course Topics	4.62	Highly Effective
Learning Activities	4.58	Highly Effective
Instructional Materials	4.55	Highly Effective
Assessment Methods	4.64	Highly Effective
Training Duration	4.21	Effective
Composite Mean	4.52	Highly Effective

**Figure 3. Bar Chart of VSEI Training Course
Component Ratings**



Results showed that the VSEI Training Course successfully achieved its instructional objectives. Respondents expressed high satisfaction regarding the relevance and comprehensiveness of course topics, indicating that the curriculum adequately covered maritime laws, inspection procedures, vessel safety standards, and regulatory requirements necessary for inspection duties.

Learning activities also received highly effective evaluations because they promoted active participation, collaborative learning, and application of inspection concepts. Instructional materials were considered comprehensive, technically accurate, and aligned with current maritime regulations, enabling participants to understand inspection procedures more effectively.

Assessment methods likewise received favorable evaluations because they appropriately measured knowledge acquisition and technical competence. Respondents particularly appreciated scenario-based assessments, practical exercises, and case analyses that closely resembled actual inspection situations.

Training duration, however, obtained comparatively lower ratings. Although still interpreted as effective, many participants believed that additional training time would allow greater mastery of practical inspection procedures and improve readiness for actual vessel inspections.

These findings indicate that curriculum quality alone is insufficient to maximize competency development (Hendro, 2021). Effective maritime training requires adequate instructional time to reinforce practical learning through repeated exposure to operational scenarios (Abid et al., 2025). From an engineering management perspective, the effectiveness of the existing VSEI Training Course demonstrates that a structured competency-based training system contributes directly to workforce capability and inspection performance. Well-designed training components improve the consistency of inspection procedures, strengthen technical decision-making, and reduce operational variability during vessel inspections. Expanding practical learning opportunities may further optimize inspection efficiency, improve operational readiness, and enhance compliance with maritime safety standards.

Effectiveness of Scenario-Based Assessment

One of the most significant findings of the study involved the effectiveness of scenario-based assessment within the VSEI Training Course.

Table 3
Perceived Effectiveness of Scenario-Based Assessment

Competency Developed	Weighted Mean	Interpretation
Technical Knowledge	4.71	Highly Effective
Decision-Making	4.76	Highly Effective
Problem-Solving	4.74	Highly Effective
Inspection Skills	4.72	Highly Effective
Operational Readiness	4.79	Highly Effective
Composite Mean	4.74	Highly Effective



Scenario-based assessment enabled participants to simulate realistic inspection situations requiring technical analysis, regulatory interpretation, and operational decision-making. Rather than relying solely on written examinations, trainees were required to identify vessel deficiencies, recommend corrective actions, prioritize inspection findings, and justify enforcement decisions.

Respondents emphasized that this instructional approach significantly improved confidence, critical thinking, and professional judgment. Because actual maritime inspections frequently involve rapidly changing operational conditions, exposure to realistic scenarios enhanced inspectors' preparedness for field operations.

From a systems engineering perspective, scenario-based assessment functions as an operational simulation that allows inspectors to integrate theoretical knowledge, technical procedures, and practical decision-making into a unified competency (Campos Toresano, 2026). Such simulation-based learning supports organizational resilience by reducing variability in inspection quality and improving consistency in regulatory enforcement. The consistently high effectiveness of scenario-based assessment further demonstrates its value as an engineering-oriented operational simulation tool. By replicating realistic inspection environments, scenario-based learning enables inspectors to integrate regulatory knowledge, technical procedures, and professional judgment under simulated operational conditions. This systems-oriented approach strengthens inspection reliability, improves decision consistency, and enhances organizational resilience by preparing inspectors for increasingly complex maritime inspection situations.

Operational Challenges Encountered During Training

Qualitative analysis identified several recurring operational challenges that affected implementation of the existing VSEI Training Program.

Table 4

Major Challenges Identified During Training Implementation

Operational Challenge	Frequency	Percentage	Interpretation
Limited Hands-on Vessel Exposure	82	81.19%	Major Challenge
Resource Constraints	76	75.25%	Major Challenge
Logistical Limitations	69	68.32%	Major Challenge
Theory-to-Practice Gap	65	64.36%	Major Challenge
Time Constraints	61	60.40%	Major Challenge

The most frequently reported concern involved limited access to actual vessels during training. Respondents explained that classroom instruction alone could not fully develop competencies required for conducting comprehensive vessel inspections. Greater exposure to operational vessels would improve technical familiarity, inspection confidence, and decision-making capability.

Resource limitations also affected training effectiveness. Participants cited shortages of inspection equipment, instructional materials, and logistical support that occasionally restricted practical learning activities.

Another recurring issue involved transferring classroom knowledge to actual inspection environments. Although trainees demonstrated adequate theoretical understanding, some experienced difficulty applying regulations when confronted with complex operational situations involving multiple vessel deficiencies or time-sensitive inspection decisions.

These findings suggest that future capacity development initiatives should prioritize experiential learning, field immersion, and simulation-based instruction alongside classroom teaching (Barasa et al., 2025; Guntoro & Simanjuntak, 2025). From a systems engineering perspective, these operational constraints represent opportunities for improving the overall performance of the VSEI organizational system. Addressing limitations in field immersion, instructional resources, logistical support, and practical inspection exposure may reduce inconsistencies in competency development while improving inspection quality, operational efficiency, and regulatory compliance. Strengthening these operational components supports continuous organizational improvement and enhances the long-term effectiveness of maritime safety enforcement.

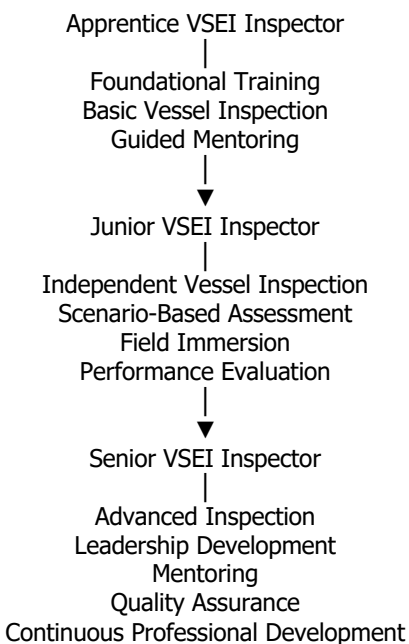
Development of the Competency-Based Capacity Development Program

The integration of quantitative and qualitative findings served as the basis for designing the proposed Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program.

Unlike conventional training approaches that primarily emphasize classroom instruction, the proposed framework establishes a structured professional development pathway based on competency acquisition and continuous performance improvement.

Figure 4

Proposed Competency-Based Career Progression Framework



The framework introduces progressive competency development through three career stages.

The Apprentice level emphasizes foundational regulatory knowledge, basic inspection procedures, and supervised operational practice.

The Junior level focuses on independent inspection capability, advanced technical assessment, operational decision-making, and competency validation through scenario-based assessments.

The Senior level develops leadership capability, mentoring responsibilities, quality assurance functions, and continuous professional development necessary for sustaining organizational excellence.

Unlike traditional one-time certification systems, this competency-based framework promotes lifelong learning through continuous assessment, refresher training, periodic competency validation, and structured career advancement.

Engineering and Maritime Innovation Implications

The principal contribution of this study extends beyond evaluating personnel competency. It introduces an integrated operational framework for strengthening maritime inspection systems using systems engineering principles.

The proposed Competency-Based Capacity Development Program represents an organizational innovation that integrates:

- competency assessment;
- standardized training;
- practical field immersion;
- scenario-based simulation;
- continuous performance evaluation;
- structured career progression; and
- organizational knowledge management.

By treating Vessel Safety Enforcement Inspection as an interconnected operational system rather than an isolated training activity, the framework improves inspection consistency, enhances regulatory compliance, supports workforce sustainability, and strengthens maritime safety governance.

These findings contribute to maritime engineering practice by demonstrating that organizational capability development is a critical engineering solution for improving vessel inspection effectiveness. The framework may also serve as a reference model for other maritime administrations seeking to modernize inspection systems and develop competency-based maritime safety programs.

Conclusions

The study demonstrated that the Philippine Coast Guard Vessel Safety Enforcement Inspection (VSEI) Program possesses a competent workforce capable of implementing maritime safety regulations and conducting vessel inspections consistent with existing operational standards. Vessel Safety Enforcement Inspection inspectors exhibited competence across the major competency domains of regulatory knowledge, technical inspection, documentation, ship familiarization, emergency response, and field application, while instructors demonstrated consistently higher competency levels attributable to their greater professional experience and instructional responsibilities.

The existing Vessel Safety Enforcement Inspection Training Course was found to be highly effective in developing inspector competencies through well-designed course content, relevant learning activities, comprehensive instructional materials, and appropriate assessment methods. Nevertheless, the study identified practical field exposure and training duration as areas requiring further enhancement to maximize competency development and operational readiness.

Scenario-based assessment emerged as one of the strongest instructional components of the training program. The findings indicate that simulation of actual vessel inspection situations significantly strengthened inspectors' technical knowledge, critical thinking, decision-making ability, operational judgment, and confidence in performing maritime safety enforcement functions. These results demonstrate the importance of experiential learning in competency-based maritime education and training.

Qualitative findings revealed that several operational constraints continue to influence training effectiveness, including limited opportunities for hands-on vessel inspection, logistical limitations, resource constraints, and challenges in translating theoretical knowledge into actual inspection practice. These challenges suggest that strengthening practical learning opportunities is essential for improving inspection consistency and organizational capability.

Based on the integration of quantitative and qualitative findings, the study developed a Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program that introduces a structured career progression framework composed of Apprentice, Junior, and Senior VSEI Inspector levels. The proposed framework integrates competency standards, field immersion, scenario-based learning, continuous professional development, mentoring, and periodic competency assessment into a unified organizational development model.

From an engineering and maritime systems perspective, the proposed framework represents an operational innovation that strengthens maritime inspection capability through systems integration rather than isolated training interventions. By combining competency assessment, continuous learning, organizational knowledge management, and structured career progression, the framework contributes to improving inspection quality, regulatory compliance, operational efficiency, and maritime safety governance.

Overall, the study demonstrates that strengthening human capital through competency-based organizational systems constitutes a sustainable strategy for improving vessel safety enforcement and supporting the Philippine Coast Guard's mandate of ensuring safe, secure, and environmentally responsible maritime transportation. The proposed Competency-Based Capacity Development Program further demonstrates that systems engineering principles can be effectively applied to maritime inspection workforce development by providing an operational model that improves inspection reliability, organizational resilience, workforce capability, and long-term maritime safety performance.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are offered:

1. The Philippine Coast Guard may institutionalize the proposed Competency-Based Vessel Safety Enforcement Inspection Capacity Development Program to establish a standardized framework for inspector qualification, competency development, and career progression.
2. Practical vessel inspection exercises and field immersion activities may be expanded to provide inspectors with greater exposure to actual inspection environments and enhance the application of theoretical knowledge during operational situations.

3. Scenario-based assessment may be further integrated into all stages of VSEI training because of its demonstrated effectiveness in improving technical competence, decision-making, operational readiness, and problem-solving capability.
4. Periodic competency reassessment, refresher training, and continuing professional development programs may be implemented to ensure that inspectors remain updated with evolving maritime regulations, international conventions, inspection technologies, and emerging operational risks.
5. Additional instructional resources, inspection equipment, and logistical support may be allocated to strengthen practical training implementation and improve learning effectiveness across different Philippine Coast Guard units.
6. A structured mentoring program involving experienced Senior VSEI Inspectors may be established to facilitate knowledge transfer, technical coaching, and professional development among newly qualified inspectors.
7. Digital learning technologies, simulation systems, and electronic inspection management platforms may be incorporated into future training programs to enhance learning efficiency, improve documentation accuracy, and support digital transformation within maritime safety enforcement.
8. Future researchers, Philippine Coast Guard districts, maritime academies, port authorities, classification societies, and other national maritime administrations may validate, adapt, and implement the proposed Competency-Based Capacity Development Program under different operational environments to further determine its applicability, effectiveness, and potential contribution to competency-based maritime inspection systems.

Engineering Contribution and Innovation

The principal contribution of this study extends beyond evaluating inspector competence. It introduces a systems-based operational framework that integrates competency assessment, structured training, scenario-based learning, career progression, mentoring, and continuous professional development into a unified capacity development model.

The proposed framework contributes to maritime engineering and organizational systems innovation by:

- strengthening operational capability through competency-based workforce development;
- improving inspection consistency and regulatory compliance;
- supporting organizational knowledge management;
- providing a scalable framework applicable to other maritime safety organizations;
- advancing sustainable maritime governance through systematic human resource development.

Unlike traditional training programs that primarily emphasize classroom instruction, the proposed framework recognizes competency development as a continuous organizational engineering process requiring regular assessment, practical experience, organizational learning, and institutional support.

Practical Implications

The findings of this study provide practical implications for maritime organizations, regulatory agencies, and training institutions.

For the Philippine Coast Guard, the proposed framework offers a structured roadmap for enhancing inspector competency while supporting organizational modernization and workforce sustainability.

For maritime training institutions, the results emphasize the value of competency-based curricula, experiential learning, and simulation-driven assessment in preparing future maritime inspectors.

For maritime regulators and policymakers, the study demonstrates that investment in competency development directly contributes to improved vessel safety enforcement, operational efficiency, and compliance with national and international maritime safety standards.

The framework may likewise serve as a reference model for other maritime administrations seeking to strengthen inspection capability through systematic human capital development. Beyond the Philippine Coast Guard, the proposed competency-based framework may also be adapted by port authorities, classification societies, maritime academies, and other national maritime administrations that seek to enhance inspection reliability, workforce capability, organizational resilience, and regulatory compliance through systems-oriented competency development. Such broader application further demonstrates the framework's potential contribution to international maritime engineering practice and maritime safety governance.



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