



Developing Marine Communication Measurement Model for Ship Officer Maritime English Competency

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Abstract. Effective marine communication is essential for ensuring navigational safety, operational efficiency, and compliance with international maritime regulations. Ship officers are required to demonstrate high levels of communication competence in both routine and emergency situations. However, existing assessment practices often focus on general language proficiency and do not adequately measure the specific communication competencies required in maritime operations. This study aims to develop a Marine Communication Measurement (MCM) Model for ship officers that provides a comprehensive and standardized framework for assessing marine communication competence. The research adopts the Research and Development (R&D) methodology proposed by Walter R. Borg and Meredith D. Gall. The development process consists of several stages, including needs analysis, literature review, model design, expert validation, pilot testing, revision, and field implementation. Data are collected from maritime education institutions and practicing ship officers. The model is designed to assess key dimensions of marine communication, including Standard Marine Communication Phrases (SMCP) proficiency, operational communication skills, and communication performance in simulated shipboard scenarios. Expert judgment and field-testing procedures are employed to examine the validity, reliability, and practicality of the proposed model. The expected outcome of this research is a valid and reliable measurement model that can be used by maritime training institutions, shipping companies, and certification authorities to evaluate and enhance ship officers' communication competence. The study contributes to the improvement of maritime education and training by providing a structured assessment framework aligned with international maritime communication standards and the competency requirements established by the International Maritime Organization (IMO) and the STCW Convention.

Keywords: *Marine Communication Measurement, Ship Officers, Research and Development (R&D)*

1. INTRODUCTION

Shipping serves as the backbone of international trade, enabling the transportation of approximately 80–90 percent of global merchandise by volume and connecting economies across continents. The efficiency of maritime transportation allows goods,

raw materials, and energy resources to move across vast distances at relatively low cost, making shipping indispensable to global economic growth and supply chain sustainability. To ensure safe and efficient operations, the maritime industry operates within a framework of international conventions and regulations established by organizations such as the International Maritime Organization (IMO). Compliance with these regulations is essential for maintaining safety, environmental protection, and operational efficiency in an increasingly complex maritime environment.

Historically, maritime safety has focused primarily on improving the physical and technological aspects of ships, including advancements in hull construction, propulsion systems, navigational equipment, and onboard automation. While these developments have significantly enhanced vessel performance and reliability, contemporary maritime operations increasingly acknowledge the critical role of the human element in ensuring safety at sea. Among the various human factors influencing maritime performance, effective communication is particularly important. Given that most vessels today are staffed by multinational crews with diverse linguistic and cultural backgrounds, Maritime English has become the internationally recognized lingua franca of the shipping industry. Proficiency in Maritime English enables seafarers to communicate clearly during routine operations, cargo handling, navigation, and emergency situations, thereby reducing misunderstandings, enhancing coordination, and minimizing the risk of accidents and operational disruptions. The growth of Maritime English has increased the need for standardized language education in Maritime Education and Training (MET). However, challenges related to assessment methods, syllabus design, teaching material, instructional approaches, and teacher qualifications continue to affect the effectiveness and consistency of Maritime English education worldwide (Basak, 2017; Cole & Trenkner, 2008; Cole et al., 2007; Pritchard, 2003). In response to the need for standardized maritime communication, the International Maritime Organization (IMO) developed the Standard Marine Communication Phrases (SMCP) to facilitate clear, concise, and unambiguous communication in maritime operations.

Standardized communication frameworks, such as the International Maritime Organization (2002), Standard Marine Communication Phrases (SMCP), provide a common linguistic foundation for maritime personnel worldwide. The consistent application of these standardized phrases helps reduce misunderstandings and communication-related human errors, which continue to be recognized as significant contributors to maritime accidents and incidents. Furthermore, accurate written documentation, including incident reports, grounding reports, damage reports, and safety records, plays a critical role in regulatory compliance, safety management, risk assessment, and legal accountability.

Therefore, Maritime Education and Training (MET) institutions must implement reliable assessment methods to measure and validate seafarers' communication competencies, ensuring that graduates are adequately prepared for the communication demands of modern maritime operations. To achieve this objective, the present study adopts the Research and Development (R&D) methodology proposed by Borg and Gall. This methodology provides a systematic framework for designing, developing, testing, evaluating, and refining educational products through iterative stages. Its application enables researchers to establish the validity, reliability, and practicality of assessment instruments, ensuring that the resulting model effectively measures maritime

communication competence in accordance with industry and regulatory requirements. The development of a Marine Communication Measurement (MCM) Model is necessary to provide a valid and reliable instrument for assessing ship officers' Maritime English competency in accordance with STCW and IMO SMCP requirements. Existing assessments often fail to measure operational communication skills comprehensively. Therefore, the Research and Development (R&D) methodology proposed by Borg and Gall is employed to systematically design, validate, test, and refine the model, ensuring its effectiveness, practicality, and relevance to contemporary maritime operational and safety requirements.

2. COMPETENCY IN SHIPPING

To ensure all shipping services meet the shipper's satisfaction, the ship must be operated by a competent seafarer. Competency in shipping refers to the ability and expertise required to handle various aspects of the shipping process efficiently and effectively. It involves a broad range of skills and knowledge necessary to ensure the smooth flow of goods from one location to another, both domestically and internationally. In fact, competency in shipping encompasses a wide range of skills and knowledge. It is crucial for shipping professionals to continually develop and refine these competencies to ensure efficient and successful shipping operations. Even seafarers who have obtained the Certificate of Competency through the competence assessment organized by the competent maritime authorities have a significant gap between their post-competency and the requirements of shipping enterprises (Fan, 2020). Fisher & Muirhead (2019) defined competency as: The concept of competency can be considered in the context of what knowledge and skill an employee needs to have to apply that knowledge and skill to the workplace situation.

“Standard of performance means the level of proficiency to be achieved for the proper performance of a function on board a ship in accordance with internationally agreed criteria as set forth herein and incorporating prescribed standards or levels of knowledge, understanding, and demonstrated skill.”

Standard of performance means the level of ability or skill in carrying out tasks on a ship that is recognized internationally. This performance also shows the level of knowledge, understanding, and skills of a seafarer on board. There is no doubt that competency is formed through successful training. Maritime education and training are the key to ensuring that crew members are adequately trained in effective communication skills and procedures is essential.

The 2010 Amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW), particularly Section A-I/1 of the STCW Code, provide a clear definition of the term standard of performance. According to the Code, a standard of performance refers to the level of proficiency that seafarers must attain to perform their duties and functions effectively and safely on board a ship. This standard is based on internationally agreed criteria and serves as a benchmark for evaluating competence in maritime operations. It incorporates the required levels of knowledge, understanding, and demonstrated skills necessary for carrying out assigned tasks. The concept emphasizes that seafarers must not only possess theoretical knowledge but also demonstrate practical competence in real

operational situations, thereby ensuring safe navigation, efficient ship operations, and compliance with international maritime regulations.

Training programs should cover aspects such as radio communication, distress signals, emergency procedures, and the use of communication equipment. Competency assessments and regular refresher training can help maintain and improve communication skills due to fulfill the minimum requirement as standardized IMO in SMCP (Standard Marine Communication Phrase). This is in line with the statement made by Maglogiannis et al. (2005) that the requirement for future maritime communication is the need for standardization of the presentation of the corresponding protocol to enable ubiquity and universality.

3. STANDARD MARINE COMMUNICATION PHRASES

Marine communication is performed in English and becomes a fundamental basis in ship-to-ship or ship-to-shore communication. As maritime operations involve multinational crews and stakeholders, effective communication is crucial for ensuring safe navigation, coordination, and information exchange in the maritime domain. Moreover, effective communication represents a key component of maritime safety, as it facilitates mutual understanding and reduces the risk of misunderstanding that may lead to operational errors and maritime accidents. Therefore, a standardized linguistic framework is essential to facilitate clear and unambiguous communication in the increasingly complex environment of global maritime trade (Bojović, 2024; Komari et al., 2025)

As an internationally recognized communication framework, the Standard Marine Communication Phrases (SMCP) are widely used on commercial ships to ensure safe navigation and standardize communication between ships and between ships and shore (Farjami, 2025). In marine communication, there are many things to be communicated, such as vessel identity, position, speed, and course, with other vessels and shore stations, situational awareness, collision avoidance, etc. Marine communication refers to the methods and systems used for communication at sea, primarily among ships, vessels, and coastal stations. Effective marine communication plays a crucial role in promoting maritime safety, efficient operations, and coordination among vessels and coastal authorities. This is an important consideration, so IMO introduced SMCP to shipping.

In 1973, the IMO Safety Committee at its 27th session meeting established standardization of the language used in shipping activities. This shipping communication standard is called SMNV (Standard Marine Navigational Vocabulary). SMNV then changed to SMCP (Standard Marine Communication). In STCW, the ability to understand and use the SMCP is set as one of the minimum standards that must be possessed by officers who carry out guard duties on ships of 500 tons or more. The communication rules in the SMCP are also contained in the STCW 1978 amendment 2010 and SOLAS (Safety of Life at Sea).

The basics of SMCP are arranged simply and are a simplification of Maritime English in order to reduce grammar, lexical, and idiomatic aspects. Simplification in verbal communication is, for example, stated by not using the, a, or an, is, or are. The principles used in the SMCP (2010) are as follows:

a. Don't use synonyms;

- b. Do not use the standard form;
- c. Use sentences with possible “yes or no” questions; and
- d. Using "one phrase for me event".

The strategic position with respect to competence in communication skills to create shipping safety can be seen in Figure 1 below.

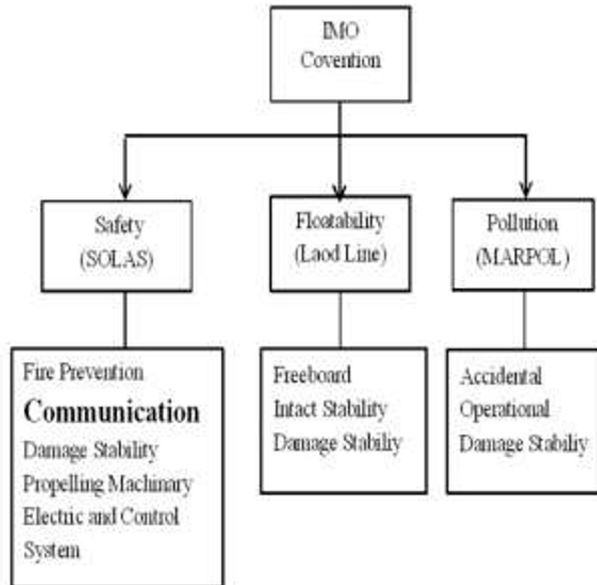


Figure 1. Ship Communication in IMO Convention

4. TROUBLESHOOTING

This study aims to design and develop a structured Marine Communication Measurement (MCM) Model to comprehensively assess ship officers' Maritime English competency. The model is intended to evaluate the essential communication skills required for internationally standardized maritime operations. Furthermore, it seeks to ensure alignment with the requirements of the STCW Convention, IMO Standard Marine Communication Phrases (SMCP), and other relevant maritime regulations, thereby providing an effective instrument for measuring and validating maritime communication competence.

5. RESEARCH AND DEVELOPMENT

This study employed the Research and Development (R&D) method developed by Walter R. Borg and Meredith D. Gall. The R&D method is a systematic research approach designed to produce, develop, and validate educational products. Borg and Gall introduced this method in their seminal work *Educational Research: An Introduction*, which remains one of the primary references for the development of educational models, curricula, instructional media, assessment instruments, and other

educational products. This method is considered appropriate for the present study, as its primary objective is to develop a valid, reliable, and applicable Marine Communication Measurement (MCM) Model for assessing the maritime communication competence of ship officers.

The development of a maritime communication measurement model is essential because communication is one of the key factors influencing maritime safety. Numerous studies have demonstrated that communication failures continue to be a significant contributing factor to maritime accidents and incidents (Sukomardojo, 2022). Therefore, a comprehensive instrument is required to assess maritime communication competence in accordance with internationally recognized standards. Such competence should be aligned with the provisions of the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) 1978, as amended, particularly the STCW Manila Amendments 2010, which emphasize communication skills as one of the core competencies of seafarers. Furthermore, the instrument must incorporate the use of the Standard Marine Communication Phrases (SMCP), established by the International Maritime Organization (IMO) as the standardized safety language for ship-to-ship, ship-to-shore, and onboard communications.

According to Gall et al. (2003), educational development research consists of ten stages: (1) research and information collecting, (2) planning, (3) developing the preliminary form of the product, (4) preliminary field testing, (5) main product revision, (6) main field testing, (7) operational product revision, (8) operational field testing, (9) final product revision, and (10) dissemination and distribution. However, to enhance the efficiency of the research process without compromising the substance of the development procedures, these ten stages were adapted into four major phases: (1) preliminary study, (2) model development, (3) model realization, and (4) model testing, evaluation, and revision.

Through the Borg and Gall R&D approach, the development of the Marine Communication Measurement Model is expected to result in an assessment instrument capable of analysing seafarers' communication competency requirements, validating Maritime English competence based on STCW and SMCP standards, and providing an accurate measurement system for maritime education institutions, shipping companies, and seafarer certification authorities. Consequently, the resulting model is expected not only to possess a strong theoretical foundation but also to address the practical needs of the modern maritime industry, where effective communication is essential for ensuring operational safety and efficiency.

6. A CLOSER LOOK AT MODEL

Required competency proficiency levels describe the level of a competency to perform a specific process successfully; these levels relate to the work required for the process. As different processes entail varying levels of complexity and performance demands, the required proficiency level for each competency may also vary. Consequently, some processes may require advanced proficiency, whereas others may require only basic competence or no particular competency at all. This view is supported by Beasley et al. (2018) and Ali et al. (2021), who argue that competency

requirements should be aligned with the level of proficiency necessary for effective job performance.

In scaling proficiency, the analysis needs a high degree of accuracy. The requested skills should be detected for every task of the process. To identify the competencies correctly, all the activities of the process must be described with the same level of detail. To obtain a homogeneous and detailed definition of the competencies of each activity, consideration should be given to the output of the activity together with the method, technology, and product required to perform an activity (Fortunato et al., 2011).

The competency assessment process is based on the proficiency level description. The following scale is used to rate the level of achievement as it occurs in marine communication. The following table 1 is originally made by Russo (2017), which is then rearranged and added columns as needed in scaling assessment competency in marine communication.

Table 1. Proficiency Scale In Marine Communication Measurement

Scale	Proficiency	Remark
A (80-100)	1. Highly developed knowledge, understanding, and application of the competency required to be successful in the job and organization (total mastery). 2. Can apply knowledge outside the scope of one's position. 3. Can coach or teach others on the competency. 4. Has a long-term perspective. 5. Helps develop materials and resources in the competency.	Very Competent
B (70-79)	1. Detailed knowledge, understanding, and application of the competency. Ability to handle non-routine problems and situations. 2. Requires minimal guidance or supervision / works independently. 3. Consistently demonstrates success in the competency. 4. Capable of assisting others in the application of the competency.	Competent
C (60-69)	1. Basic understanding or knowledge needed for the job. 2. Basic understanding and knowledge sufficient to handle routine tasks. 3. Requires some guidance or supervision when applying the competency. 4. Understands and can discuss terminology and concepts related to the competency.	Re-Training
D (50-59)	1. Limited or no use of the competency required for the job. 2. Competency has been minimally demonstrated.	Immediate Re-Training

	3. May have had limited opportunity to apply the competency. 4. May have a limited understanding of the competency.	
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Proficiency is shown in numbers. The size of the numbers also shows the level of Proficiency. Each of these numbers has a verbal description represented: grades A: very competent, B: competent, and C: retraining. D: immediate re-training. Proficiency assessment of a person is done by marking the appropriate numbers. The rubric is usually displayed in a table of criteria placed to the left or right of the Proficiency column whose achievement is measured. The following table 2 is a rubric used to assess competency in marine communication.

Table 2. Performance Scale In Marine Communication Measurement

Criteria /Scale	A (80-100)	B (70-79)	C (60-69)	D (50-59)
Remark	Very Competent	Competent	Re-Training	Immediate Re-Training
Procedure	Procedure according to the situation at hand.	Procedure according to the situation at hand.	The procedure does not match the situation at hand.	The procedure is inappropriate and threatens safety.
Action Taken	Actions in the order of the procedure. Performance is very convincing and very meaningful.	There is an error in the sequence of procedures. Convincing and meaningful performance.	Take no action. Performance is less convincing and less meaningful.	Taking action outside the procedure and threatening safety. Inconclusive and meaningless performance.
Communication	Communication uses standards communication. Communication is well done without repetition. Standard terminology is consistency used.	Communication uses standards communication Understandable but with repetition Standard terminology is used but with repetition.	Does not use standards communication. Wrong word order and keeps repeating. Standard terminology does no use.	Does not use standards communication and threatens safety. communication is difficult to understand and keeps repeating. Standard terminology does no use.

7. COMPETENCY IDENTIFICATION

The level of competency is determined based on the combined results of proficiency and performance assessments in marine communication. Proficiency reflects the individual's knowledge and understanding of marine communication principles, while performance measures the ability to apply these competencies in practical situations. The competency score is calculated by adding the proficiency score and the performance score according to the assessment criteria presented in Tables 1 and 2. The total score is then divided by two to obtain an average value. This average score represents the individual's overall competency level and serves as the basis for classifying competency achievement according to the established assessment standards. The formula is mathematically as follows:

$$\frac{\text{Proficiency Scale} + \text{Performance Scale}}{2} = \text{competency score}$$

Determination of the level of competency in marine communication is finally determined using the following table 3:

Table 3. Competency Level

Average	level of competency
$80 < C \leq 100$	Very Competent
$70 < C \leq 79$	Competent
$60 < C \leq 69$	Re-Training
$50 < C \leq 59$	Immediate Re-Training

8. STATISTICAL TESTING

To ensure that the Marine Communication Measurement (MCM) Model is both valid and reliable, statistical testing was conducted. Validity testing aims to determine whether the instrument accurately measures the construct it is intended to assess, namely, ship officers' Maritime English competency. In this study, content validity was evaluated using **Aiken's V**, which measures the degree of agreement among expert judges regarding the relevance and representativeness of each questionnaire item. Reliability testing, on the other hand, was performed to assess the consistency and stability of the instrument. **Cronbach's Alpha** was employed to examine the internal consistency of the questionnaire items, indicating the extent to which the items measure the same underlying construct. The application of these statistical procedures is essential in instrument development research because it provides empirical evidence that the measurement model is capable of producing accurate and dependable results (Aiken, 1985; Tavakol & Dennick, 2011). Therefore, the validity and reliability analyses serve as important indicators of the quality and suitability of the MCM Model for assessing Maritime English competency among ship officers.

9. VALIDITY

The average Aiken's V coefficient was 0.953, indicating that all items in the Marine Communication Measurement (MCM) Model instrument possess excellent

content validity. All items achieved coefficients above 0.90, suggesting that no item needs to be eliminated or substantially revised. These findings indicate a very high level of agreement among Maritime English experts and Marine Officers that the instrument items accurately and comprehensively represent the construct of Maritime English competency intended to be measured. Therefore, the instrument can be considered highly appropriate for assessing the targeted competencies and suitable for further implementation and reliability testing.

"The content validity of the Marine Communication Measurement (MCM) Model was assessed using Aiken's V. The analysis involved 15 expert validators consisting of five Maritime English lecturers and ten marine officers. The Aiken's V coefficients ranged from 0.917 to 1.000, with an overall average coefficient of 0.953. Since all values exceeded the recommended threshold of 0.80, the instrument demonstrated excellent content validity and was considered suitable for further reliability testing and field implementation."(Aiken, 1985).

10. REALIBILITY

A Cronbach's Alpha coefficient of -1.493 indicates that the data do not satisfy the assumptions of internal consistency reliability. However, in this case, the negative coefficient does not imply that the instrument is poor or unreliable. Rather, it can be attributed to several factors: (1) the variation in responses was extremely limited, as nearly all respondents assigned ratings of 4 or 5; (2) Item 10 exhibited zero variance because all respondents gave the same score of 5; (3) the variance of the total scores (0.238) was smaller than the sum of the item variances (0.505), resulting in a negative alpha coefficient; and (4) the number of respondents was relatively small ($n = 15$) for obtaining a stable reliability estimate.

Because all validators provided very high, highly homogeneous ratings, Cronbach's Alpha is not an appropriate indicator of reliability at the expert validation stage (expert judgment). In Research and Development (R&D) studies, instrument reliability should be re-examined through field testing involving a larger sample of respondents to ensure sufficient response variability and to obtain a more accurate and stable estimate of internal consistency reliability.

The reliability analysis using Cronbach's Alpha produced a coefficient of -1.493 . This negative value resulted from the extremely homogeneous responses of the expert validators, with most ratings concentrated at the highest scale points (4 and 5) and one item showing zero variance. Therefore, the coefficient does not indicate poor instrument quality but rather reflects insufficient response variability during the expert validation stage. Consequently, reliability testing should be conducted again during field implementation involving a larger sample of ship officers to obtain a more stable estimate of internal consistency.

11. CONCLUDING REMARKS

Competency assessment is essential for ensuring and enhancing seafarers' professional performance in accordance with the competency standards established by the STCW Convention. Although STCW defines the required competencies, it provides limited guidance on specific assessment procedures, creating a need for structured and

objective measurement models. The Marine Communication Measurement (MCM) Model developed in this study addresses this gap by integrating proficiency- and performance-based indicators that reflect authentic maritime communication practices. The model enables a comprehensive evaluation of seafarers' Maritime English competency and supports the identification of strengths and areas for improvement. Statistical testing demonstrated that the instrument possesses excellent content validity, with an average Aiken's V coefficient, indicating strong expert agreement regarding item relevance. Furthermore, the validation results confirmed that the model is appropriate for measuring marine communication competency and can serve as a reliable framework for future field implementation and competency assessment in maritime education and training.

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