Assessing the Competency Level Management of Thai Deck Cadets in the Digital Age

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Abstract

This research aims to identify the competency level management of Thai deck cadets in the digital age and to examine the competencies of Thai deck cadets to determine whether competency varies across different vessel types. The research population includes navigation officers engaged in assessing deck cadet training, with a total of 366 respondents. The research methodology involved exploring concepts, theories, international conventions, and related research. These were integrated into a questionnaire comprising 31 competencies across five competency domains: Navigation, Cargo Handling and Stowage, Controlling the Operation of the Ship and Care for Persons on Board, Soft Skills, and Information Technology. The research results revealed that the overall competency of deck cadets is at a good level. When examining specific aspects, it was found that competencies in four domains are at a high level, while competency in information technology is at a moderate level. Furthermore, ANOVA was employed to assess the variation of foundational competencies across different types of vessels. The findings indicate that these competencies can serve as foundations for various types of cargo vessels in the digital era. As a result, educational institutions specializing in maritime education are well-suited to use these competencies and competency levels as a basis for planning the advancement of Thai deck cadet competencies in the future.

Keywords: Deck Cadets, Navigation Officer, STCW, IMO, Competencies

1. Introduction

1.1 Background and Importance of the Problem

Maritime transportation management is the most important mode of transportation for international trade in terms of both volume and value of goods compared to other types of transportation (Makkawan & Maungpan, 2021). Ships are the primary vehicles used for maritime transportation. There are various types of ships, including general cargo ships, bulk carriers, tankers, container ships, Ro/Ro (Roll-on/Roll-off) ships, passenger ships, and more. The operation of these ships is carried out by seafarers. The crew members on board the ships are divided into two main departments: the Navigation department and the Engineering department. The ship's navigation officer, who is responsible for the ship's navigation, plays a crucial role in ensuring the safety of the ship, cargo, and crew members. They are responsible for the loading and discharging of cargo during voyages and between different ports. The competence and experience of the ship's master, chief officer, and navigation officer are considered vital for the safe management and operation of the ship (IMO, 2011; Yoshida et al., 2020). To obtain experienced and competent navigation officers who meet the required standards, individuals aspiring to become navigation officers must undergo the process of becoming deck cadets or trainee navigation officers. They are required to undergo theoretical studies and practical training at sea for a minimum of one year, following the contents of learning and competencies set by the International Maritime Organization (IMO) in the Standards of Training, Certification, and Watchkeeping for Seafarers (STCW) (IMO, 2011). In the case of Thailand, it is one of the signatory states that have ratified the STCW Convention. Therefore, Thailand must adhere to the provisions outlined in the STCW Convention. The Marine Department is responsible for supervising the training of Thai ship's navigation officers to ensure compliance with the agreed-upon standards. Upon meeting the requirements and standards set forth, individuals can obtain a certificate of competency from the Thai Marine Department, enabling them to work as navigation officers onboard ships. It can be observed that the theoretical studies and practical training during the deck cadet phase are crucial. Deck cadets acquire knowledge and experience that will be applied when they transition into the role of a navigation officer.

Currently, the world of technology has rapidly developed and been extensively incorporated into almost every aspect of business operations, including the maritime industry. Presently, the traditional form of navigation is gradually shifting towards autonomous navigation in the maritime industry. However, the competencies outlined for deck cadets in the curriculum established by the IMO in the STCW Convention have not been adapted to accommodate autonomous navigation. This adaptation is crucial for the future role of the maritime industry in the digital age. There is currently limited research on the development of competencies specifically for Thai deck cadets and navigation officers.

1.2 Research Question

It is essential to investigate the competencies of deck cadets, focusing on the existing competency levels management of Thai deck cadets for their effectiveness in the digital age of the maritime industry. Identifying the current competency levels will facilitate the identification of areas requiring improvement or enhancement of competencies to ensure efficient performance in the digital age of maritime navigation.

1.3 Research Objective

1. To identify the competency levels management of Thai deck cadets in the digital age.

2. To examine the competencies of Thai deck cadets and determine whether competency varies across different vessel types.

2. Literature Review

2.1 Related Concepts and Theories

2.1.1 Competency Management

Spencer gives definition of a competency is an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation. Competencies can be divided into two categories, "threshold" and "differentiating,". Differentiating competency means are factors that make a person perform high than average performers. Threshold competencies are the essential characteristics, usually knowledge or basic skill describe competency by iceberg model. Surface of the water is knowledge and skill. It's the part that can be seen and can be easily developed. Knowledge and skills affect an individual's work or performance. Spencer, defined as clusters of interrelated knowledge, skills, values, attitudes, and personal characteristics that are important for successful performance on the job, competencies influence the performance of individual employees and managers (Boyatzis, 1982; Spencer & Spencer, 1993; Wong, 2021) . Additionally, there are definitions provided for competencies that are consistent and similar to those in Table 1.

Table 1 Competency Definition

Competency definition	Reference
The term " standard of competence" refers to the level of proficiency required for the proper performance of tasks on board a ship, in accordance with the herein specified internationally accepted standards. This involves establishing levels of knowledge, comprehension, and practical expertise.	(IMO, 2014)
The knowledge and skills set that must be created in professional education to stay up with the current industrial revolution are directly tied to how crucial it is for businesses, governments, and universities to work together.	(Kipper et al., 2021)
The amalgamation of skill, knowledge and behaviors that an individual possesses and applies to their role to execute their duties competently, with regard to efficiency, safety, and efficacy.	(Ocimf & Intertanko, 2018)
A widely accepted concept among competence definitions is that it comprises interconnected components of knowledge, skills, and attitudes that can be effectively applied to accomplish a professional task.	(Baartman & Bruijn, 2011)
Nursing competency refers to knowledge and skills necessary for performing safely and effectively.	(Chen et al., 2020)

2.1.2 Deck Cadets' Competency

IMO has stipulated the knowledge and skills required for seafarers in all positions through training programs outlined in the STCW Convention. The training details for each function are to develop a navigation officer specified in table A-II/1 (specification of minimum standard of competence for officers in charge of a navigational watch on ships of 500 gross tonnage or more). The course outline is provided in IMO Model Course 7.03, emphasizing the importance of knowledge, skill, and proficiency for each competency. There are three standard competency domains (1-3) and two additional competency domains (4-5) for training must recognize, and the details of all total five domains their respective competencies are as follows:

Standard Competency Domains

1) Navigation function consists of 9 competencies; Plan and conduct a passage and determine position, Maintain a safe navigational watch, Use of radar and ARPA to maintain safety of navigation, Use of ECDIS to maintain the safety of navigation, Respond to emergencies, Respond to a distress signal at sea, Use the IMO Standard Marine Communication Phrases and use English in written and oral form, Transmit and receive information by visual signaling, and maneuver the ship.

2) Cargo handling and stowage function consists of 2 competencies; Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes & Inspect and report defects and damage to cargo spaces, hatch covers and ballast tanks.

3) Controlling the operation of the ship and care for persons on board function consists 8 competencies; Ensure compliance with pollution prevention requirements, Maintain seaworthiness of the ship, Prevent control and fight fire on board, Operates Life-saving appliance, Apply medical first aid onboard ship, Monitor compliance with legislative requirement, Application of leadership and Teamwork skill, Contribute to the safety of personnel and ship (IMO, 2014; IMO, 2011; Sharma, Kim, Nazir & Chae, 2019).
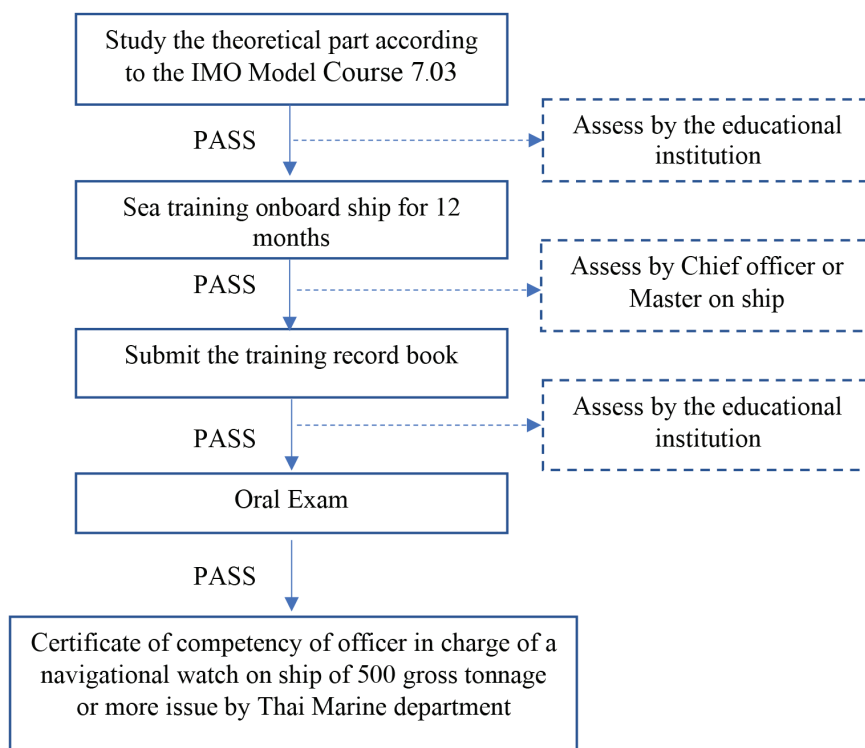
Additional Competencies

4) Information Technology, Nowadays, the concept of a seaman has been transformed by technology, which has affected the work processes, education and training, and ongoing procedures in their field. This shift in technology has necessitated a change in the training and education of seafarers to ensure they have the necessary skills to adapt to these changes in their work environment (Oksavik et al., 2020; Kongsvik et al., 2020). It is found that there are a total of 5 important Information Technology competencies that deck cadets must have for their future work on board ships. These competencies include Computing, Information and Data Processing, IT Skill, IT Security and Safety, and Knowledge regarding electronic equipment and System Integration knowledge (Cicek et al., 2019; Kipper et al., 2021; Kongsvik et al., 2020; Oksavik et al., 2020; Sharma and Kim, 2021; Wongpet & Moungpan, 2021).

5) Soft skills are abilities that help deck cadets succeed in their jobs. These include Team working, Communication and influencing, Situation awareness, Decision making, Results focus, Leadership and managerial skill, Ability to work under pressure (Fai et al., 2020a; Fai, Li, Ma and Wang, 2020b; Kipper et al., 2021; OCIMF and INTERTANKO, 2018; Vasanthakumari, 2019). Developing and mastering these skills can help seafarers build successful careers and contribute to the safe and efficient operation of the ships they work on.

In addition to completing the prescribed education, deck cadets must also undergo practical training on a ship for a minimum duration of 12 months. Afterward, they are required to return to the educational institution where they studied as deck cadets to take the evaluation exam. Only upon passing this exam, will they receive the Certificate of Competency from the Thai Marine Department. With the Certificate of Competency in hand, they can then work on a ship in the position specified in the Certificate of Competency.

2.1.3 Deck Cadets' Assessment

The competency assessment of deck cadets consists of two parts. The first part involves evaluation by the educational institution, which assesses the theoretical knowledge acquired by the deck cadet through the IMO Model Course 7.03 curriculum. The second part involves evaluation by the chief officer and master onboard, focusing on the practical aspects for 12 months period of deck cadet's training on cargo ships. The assessment of the deck cadet encompasses both theoretical and practical aspects in the following functions: navigation at the operational level, cargo handling and stowage at the operational level, and controlling the operation of the ship and care for persons on board at the operational level. After completing the theoretical education and successfully undergoing practical training on cargo ships, the deck cadet must prepare a training record book. This record book should demonstrate the details of their practical training covering all three functions mentioned earlier: avigation at the operational level, cargo handling and stowage at the operational level, and controlling the operation of the ship and care for persons on board at the operational level. The deck cadet then submits the training record book to the educational institution for evaluation. The institution assesses the record book through assessors qualified by the Thai Marine Department. Upon successful evaluation, the deck cadet proceeds to take an oral examination to demonstrate their knowledge. After passing this assessment, they receive a certificate acknowledging their completion of the training course as per IMO Model Course 7.03 curriculum. Subsequently, they can receive the Certificate of Competency Certificate of competency of officer in charge of a navigational watch on ship of 500 gross tonnage from Thai Marine Department. The process of assessment of deck cadets is present in Figure 1.

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┌─────────────────────────────┐
│ Study the theoretical part  │
│ according to the IMO Model  │
│ Course 7.03                 │
└─────────────────────────────┘
         │ PASS          ┄┄┄┄▶ ┌─────────────────────────┐
         ▼                     │ Assess by the educational│
┌─────────────────────────────┐│      institution        │
│ Sea training onboard ship   │└─────────────────────────┘
│ for 12 months               │
└─────────────────────────────┘
         │ PASS          ┄┄┄┄▶ ┌─────────────────────────┐
         ▼                     │ Assess by Chief officer  │
┌─────────────────────────────┐│   or Master on ship     │
│ Submit the training record  │└─────────────────────────┘
│ book                        │
└─────────────────────────────┘
         │ PASS          ┄┄┄┄▶ ┌─────────────────────────┐
         ▼                     │ Assess by the educational│
┌─────────────────────────────┐│      institution        │
│ Oral Exam                   │└─────────────────────────┘
└─────────────────────────────┘
         │ PASS
         ▼
┌─────────────────────────────┐
│ Certificate of competency of│
│ officer in charge of a      │
│ navigational watch on ship  │
│ of 500 gross tonnage or more│
│ issue by Thai Marine        │
│ department                  │
└─────────────────────────────┘
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Figure 1 Process of Assessment of Deck Cadets

2.2 Literature Surveys

Here are some examples of studies related to the competency of seafarer deck cadets and navigation officers: Oksavik et al. (2020) and Kongsvik et al. (2020) have elucidated that the significance of seafarers within maritime transport has been consistently crucial, owing to their indispensable skill set and specialized knowledge encompassing ship navigation, operation, safety protocols, and the expected ethical conduct and collaboration with fellow crew members. However, the advent of technology has brought about a transformation in the role of seafarers, influencing their work procedures, educational paradigms, and ongoing practices within their domain. This technological shift has necessitated a corresponding evolution in seafarers' training and education to equip them with the requisite proficiencies to adeptly navigate these changes in their operational milieu. The research by Cicek et al. (2019) the study was conducted by utilizing a dataset from the industry 4.0 context to identify newly required skills for maritime operations. Sharma & Kim (2021) studied to determine the competencies of navigation officers suitable for working in the field of autonomy. This was achieved by investigating three competency dimensions outlined in the STCW using a questionnaire comprising 66 Knowledge Understanding and Proficiency (KUP). Data was collected from a total of 82 navigation officers. The study yielded insights into the required knowledge and skills for navigation officers to operate autonomous ships. Additionally, it suggested the need for further research in the realm of technological advancements. Wongpet & Moungpan (2021) conducted a study to explore the competencies of Thai deck cadets. They collected data by surveying a total of 114 individuals, including personnel from shipping companies and Thai seafarers. The study focused on three aspects: desirable behaviors, knowledge, and skills. The overall findings indicated a high level of competency, with knowledge and skills being at a moderate level.

3. Research Methodology

3.1 Research Design

The research framework is illustrated in Figure 2. Descriptive statistics were employed to gather basic information about the respondents' using percentages. These were used to analyze the performance of deck cadets. Additionally, ANOVA was utilized by the researchers to ascertain whether competency of Thai deck cadets differs across various types of vessels.
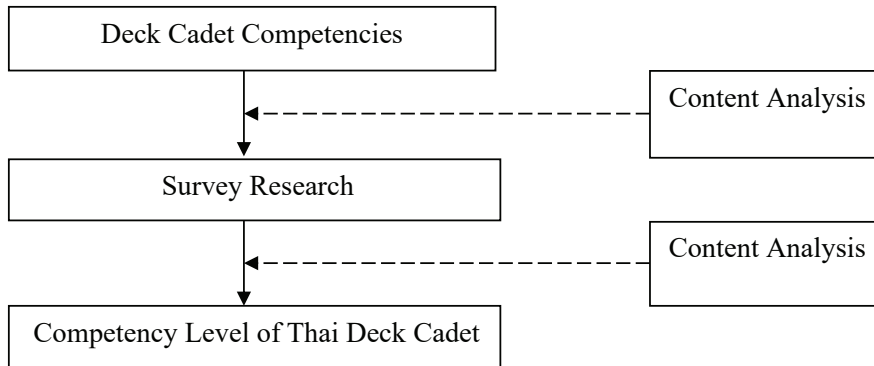

Figure 2 Research Framework

3.2 Population and Sample

The population of this research is ship's officers involved in assessing deck cadet training. According to the AD 2015 examination regulations of the Thai Marine Department, the total population of respondents in Thailand is 2,957 people (Thai Marine Department, 2022). The sample size for this research is calculated using the Taro Yamane formula with a confidence level of 95%, resulting in a total sample size of 353 people.

3.3 Research Instruments

The questionnaire was used as research instrument, which consists of 3 parts. The first part includes general information about the respondents. The second part focuses on surveying the competency levels of STCW and additional competencies required to be performed by deck cadets, which can be assessed by experienced ship officers. The responses are measured on a 5-point Likert scale, divided into 5 competency domains. In each competency domain, the respondents are required to consider their levels of knowledge, skills, and attitudes. The questionnaire comprises a total of 31 questions covering different competencies, including Navigation (9 questions), Cargo Handling and Stowage (2 questions), Controlling the operation of the ship and care for persons on board (8 questions), soft skills (7 questions), and information technology (5 questions). Finally, the last part consists of an Open-ended Form, where respondents can provide suggestions. The questionnaire was tested by five experts using the Item-Objective Congruence (IOC) method (Nuansri & Pantuworakul, 2019), and it was found to be satisfactory. Additionally, the researchers conducted a pilot test with a sample of 35 participants, and the reliability, measured by Cronbach's alpha, was found to be 0.979. Therefore, we can conclude that the questionnaire exhibits excellent reliability.

3.4 Data Collection

The researchers employed a probability sampling method to collect data from the population, which consisted of Thai ship's navigation officers with prior experience in training and evaluating deck cadets. The research utilized an online questionnaire distributed via links to educational institutions and international shipping companies. This approach aimed to facilitate the distribution of the questionnaire to respondents who hold positions as ship's navigation officers and above (chief officers, or master). The data collection took place during the period of May to June 2023. Specified sample size of 353 or above.

3.5 Statistics Used for Data Analysis

The researchers conducted data analysis using SPSS version 27. For assessing the competency level of Thai deck cadets, the analysis involved calculating the mean ($\bar{x}$), standard deviation (S.D.), and interpreting the results. The researchers compared the calculated mean with the criteria. The interpretations are as follows:

- Mean ($\bar{x}$) 4.51 - 5.00 indicates that the competency level of Thai deck cadets is at the highest level.
- Mean ($\bar{x}$) 3.51 - 4.50 indicates that the competency level of Thai deck cadets is at a high level.
- Mean ($\bar{x}$) 2.51 - 3.50 indicates that the competency level of Thai deck cadets is at a moderate level.
- Mean ($\bar{x}$) 1.51 - 2.50 indicates that the competency level of Thai deck cadets is at a low level.
- Mean ($\bar{x}$) 1.00 - 1.50 indicates that the competency level of Thai deck cadets is at the lowest level.

This ANOVA test is a technique using to compare means of two or more samples for determining whether there are any statistically significant differences between the means of three or more independent groups (Howell, 2002; Maungpan, 2019)

4. Data Analysis and Findings

4.1 Introduction

After collecting the questionnaires, a total of 374 respondents returned the questionnaires. The researchers reviewed the data's integrity and identified incomplete entries from some respondents. Additionally, some respondents had never evaluated the competencies of deck cadets on ships, necessitating the removal of their data to ensure research accuracy. As a result, the final dataset consisted of 366 respondents, surpassing the initially specified sample size of 353. Subsequently, the collected data was analyzed using statistical techniques, including frequency distribution, percentages, standard deviation and ANOVA.

4.2 Data Analysis of the Quantitative Data

General Information of Respondents: A total of 366 respondents participated in the questionnaire. It was observed that most respondents were employed in the dry bulk vessel type, accounting for 40.71%. The subsequent vessel types were container vessels at 24.32%, general cargo vessels at 20.22% , and tankers at 14.75% . Regarding positions held by the respondents, the most

respondents were third officers at 36.07%, followed by second officers at 29.78%, chief officers at 23.22%, and masters at 10.92%. All respondents hold certificates of competency from the level of navigation officer and above (chief officer, and master). This suggests that they have the requisite knowledge and expertise in maritime operations and extensive experience in training and assessing deck cadets onboard. This ensures the respondents' suitability and alignment to the survey, contributing to the accuracy and reliability of the research findings in evaluating the competency level of Thai deck cadets in the digital age. The research findings on the competency level of onboard training for Thai deck cadets, as summarized in Table 2,

Table 2 Summary of the Competency Level of Onboard Training for Thai Deck Cadets

Competency Domain	Mean	S.D.	Level of Competency
Navigation	3.66	0.87	High
Cargo handling and stowage	3.62	0.91	High
Controlling the operation of the ship and care for persons on board	3.65	0.89	High
Soft Skill	3.52	0.82	High
Information Technology	3.33	0.80	Moderate
Total	3.56	0.86	High

Based on Table 2, the competency level of Thai deck cadets, as assessed through onboard training by onboard assessors who participated in the questionnaire, is categorized into five domains. The research findings reveal that the overall competency level of Thai deck cadets in the digital age is rated as 'high' ($\bar{x}$ = 3.56, S.D. = 0.86). Upon individual domain evaluation, the competency levels are also rated as 'high' for navigation (3.66), cargo handling and stowage (3.62), controlling the operation of the ship and care for persons on board (3.65), and soft skills (3.52). The competency level in Information Technology is categorized as 'moderate' (3.33).

Table 3 Analysis Results of Competency Levels in Onboard Training for Thai Deck Cadets in the Digital Age: Navigation Domain

Competencies	Mean	S.D.	Level of Competency
Navigation Domain	3.66	0.87	High
Plan and conduct a passage and determine position	3.72	0.82	High
Maintain a safe navigational watch	3.90	0.78	High
Use of radar and ARPA to maintain safety of navigation	3.83	0.85	High
Use of ECDIS to maintain the safety of navigation	3.68	0.81	High
Respond to emergencies	3.67	0.88	High
Respond to a distress signal at sea	3.59	0.91	High
Use the IMO Standard Marine Communication Phrases and use English in written and oral form	3.41	0.89	Moderate
Transmit and receive information by visual signaling	3.46	0.88	Moderate
Manoeuvre the ship	3.66	0.91	High

Based on Table 3, the competency level of deck cadets in the Navigation domain is found at a high level overall, with an average score of 3.66. Upon detailed examination, it is revealed that 'Maintain a safe navigational watch' stands as the highest competency, with an exceptional average

score of 3.90, categorized as 'high' level. Following this, the competencies are ranked as follows: use of radar and ARPA to maintain safety of navigation (3.83), plan and conduct a passage and determine position (3.72), use of ECDIS to maintain the safety of navigation (3.68), respond to emergencies (3.67), maneuver the ship (3.66), respond to a distress signal at sea (3.59), transmit and receive information by visual signaling (3.46), and Use the IMO standard marine communication phrases and use English in written and oral form (3.41).

Table 4 Analysis Results of Competency Levels in Onboard Training for Thai Deck Cadets in the Digital Age: Cargo Handling and Stowage Domain

Competencies	Mean	S.D.	Level of Competency
Cargo handling and stowage Domain	3.59	0.92	High
CS01 Monitor the loading, stowage, securing, care during the voyage and the unloading of cargoes	3.62	0.91	High
CS02 Inspect and report defects and damage to cargo spaces, hatch covers and ballast tanks	3.57	0.94	High

Based on Table 4, the competency level in the Cargo Handling and Stowage domain is classified as 'high' within the overall assessment, with an average score of (3.59). Upon evaluating each specific competency, it is evident that deck cadets exhibit a 'high' competency level in both of the following; Monitor the loading, stowage, securing, and care during the voyage and the unloading of cargoes (3.62) and Inspect and report defects and damage to cargo spaces, hatch covers and ballast tanks (3.57).

Table 5 Analysis Results of Competency Levels in Onboard Training for Thai Deck Cadets in the Digital Age: Controlling the Operation of the Ship and Care for Persons on Board Domain

Competencies	Mean	S.D.	Level of competency
Controlling the operation of the ship and care for persons on board Domain	3.65	0.89	High
CP01 Ensure compliance with pollution prevention requirements	3.69	0.85	High
CP02 Maintain seaworthiness of the ship	3.63	0.92	High
CP03 Prevent, control and fight fire on board	3.77	0.84	High
CP04 Operates Life-saving appliance	3.77	0.98	High
CP05 Apply medical first aid onboard ship	3.30	0.82	Moderate
CP06 Monitor compliance with legislative requirement	3.55	0.88	High
CP07 Application of leadership and Teamwork skill	3.66	0.85	High
CP08 Contribute to the safety of personnel and ship	3.80	0.87	High

Based on Table 5, the competency level in the controlling the operation of the ship and care for persons on board domain is classified as 'high' within the overall assessment, with an average score of (3.65). Upon analyzing individual competencies, it is evident that deck cadets showed a 'high' competency level in all seven competencies, as follows: contribute to the safety of personnel and ship (3.80), prevent, control and fight fire on board (3.77), operates Life-saving appliance (3.77), ensure compliance with pollution prevention requirements (3.69), application of leadership and teamwork skill (3.66), maintain seaworthiness of the ship (3.63), and monitor compliance with

legislative requirement (3.55). Furthermore, there is one competency that falls under the 'moderate' level, which is 'apply medical first aid onboard ship' with an average score of 3.30.

Table 6 Analysis Results of Competency Levels in Onboard Training for Thai Deck Cadets in the Digital Age: Soft Skill Domain

Competencies	Mean	S.D.	Level of Competency
Soft Skill Domain	3.52	0.82	High
Teamwork	3.63	0.79	High
Communication and influencing	3.52	0.82	High
Situation awareness	3.42	0.79	Moderate
Decision making	3.43	0.87	Moderate
Results focus	3.52	0.80	High
Leadership and managerial skill	3.45	0.84	Moderate
Ability to work under pressure	3.68	0.82	High

The Table 6, provides an overview of the soft skill domain's competency level, classified as 'high' with an average score of 3.52. Upon examining the detailed competencies, it becomes evident that there are four competencies within the 'high' level. The competency 'ability to work under pressure' holds the highest level of ability among deck cadets in this domain (3.68), followed by team working (3.63), communication and influencing (3.52), results focus (3.52). Additionally, three competencies fall within the 'moderate' level as follows: leadership and managerial skill (3.45), decision making (3.43), and situation awareness (3.42).

Table 7 Analysis results of competency levels in onboard training for Thai deck cadets in the digital age: Information Technology domain

Competencies	Mean	S.D.	Level of competency
Information Technology Domain	3.33	0.80	Moderate
Computing, Information and Data Processing	3.48	0.75	Moderate
IT Skill	3.42	0.83	Moderate
IT security and safety	3.33	0.84	Moderate
Knowledge regarding electronic equipment	3.27	0.76	Moderate
System Integration knowledge	3.18	0.79	Moderate

The Table 7 provides the overall competency level in the Information technology domain, which falls within the 'moderate' level with an average score of 3.33. Upon considering the various competencies within this domain, it becomes evident that each competency resides in the 'moderate' level. The competencies can be ranked as follows: computing, information and data processing (3.48), IT Skill (3.42), IT security and safety (3.33), knowledge regarding electronic equipment (3.27), and system integration knowledge (3.18).

Tables 2 to 7 provide insights into the research findings, enabling the identification of competency levels among Thai deck cadets. The research outcomes offer a clear overview and a detailed ranking of competencies within different domains. Considering the vital role these competencies play in shipboard operations, particularly for navigation officers, the researchers conducted ANOVA analysis to compare the competency levels, covering five domains: navigation,

cargo handling and stowage, controlling the operation of the ship and care for persons on board, soft skill, and information technology, in relevance to various types of vessels.

In this section, a descriptive analysis was conducted to examine the differences in the importance levels among five domains of Thai navigation officers in the digital age. The analysis considered the four types of vessels: dry bulk, container, general cargo, and tanker, as shown in Table 8.

Table 8 One-way ANOVA Results for Each Type of Vessel

NOC Domain	Average of Competencies Level for Each Type of Vessel					F-Ratio	P Value
	Dry Bulk	Container	General	Tanker	Mean		
NAV	3.62	3.63	3.57	3.81	3.64	1.568	0.197
CGO	3.74	3.62	3.70	3.67	3.69	0.361	0.782
COP	3.55	3.74	3.69	3.67	3.65	1.624	0.183
SOF	3.57	3.55	3.50	3.35	3.52	1.671	0.173
IT	3.34	3.39	3.26	3.31	3.33	0.638	0.591

Note: NOC; navigation officer competency, NAV; navigation, CGO; cargo handling and stowage, COP; controlling the operation of the ship and care for persons on board, SOF; soft skill, IT; Information Technology

Table 8 presents the competency levels of deck cadets assessed by onboard assessors in the five competency domains for each type of vessel. Upon examining dry bulk vessels, it is evident that in the cargo handling and stowage domain (CGO), deck cadets achieved the highest competency level (3.74), followed by navigation (NAV, 3.62), soft skills (SOF, 3.57), controlling the operation of the ship and care for persons on board (COP, 3.55), and information technology (IT, 3.34) at a moderate level. For container ships, the competency level was highest in the controlling the operation of the ship and care for persons on board domain (COP, 3.74), followed by navigation (NAV, 3.63), cargo handling and stowage (CGO, 3.62), soft skills (SOF, 3.55), and information technology (IT, 3.39). In the case of general cargo ships, the competency level in the cargo handling and stowage domain (CGO) ranked highest at 3.70, followed by controlling the operation of the ship and care for persons on board (COP, 3.69), navigation (NAV, 3.57), soft skills (SOF, 3.50), and information technology (IT, 3.26). Regarding tanker ships, the navigation domain (NAV) exhibited the highest competency level (3.81), followed by cargo handling and stowage (CGO, 3.67), Controlling the operation of the ship and care for persons on board (COP, 3.67), soft skills (SOF, 3.35), and information technology (IT, 3.31).

While differences were observed in the test results based on the type of vessel reported by the respondents, the outcomes of the ANOVA test indicated that these differences were not statistically significant ($p > 0.05$). This allows the researchers to conclude that the competency levels of Thai deck cadets in the digital age, within each domain, are not significantly specific to the vessel type. It can be considered a standard that these competency levels can be applied across various types of vessels. The overall competency level of Thai deck cadets was found to be in the good range; however, it is positioned closer to the moderate level of competence. Therefore, there is a pressing need to accelerate the development of competency levels.

5. Conclusion, Discussion, and Recommendation

5.1 Conclusion

Educational institutions and training centers for deck cadets can utilize the findings of this research as a reference for designing curricula and classroom teaching methodologies. This utilization aims to expedite the enhancement of deck cadet performance in competencies categorized as moderate, elevating them to higher levels. For competencies that are already at a high level, institutions must either maintain or further enhance these standards. The competencies attained from this research serve as a foundation for navigation officers working on dry bulk carriers, container ships, general cargo ships, and tankers.

5.2 Discussion

The competencies acquired by deck cadets through this study for shipboard operations can also be applicable for the role of a ship's navigation officer. Upon completing a 12-month onboard training on cargo vessels and obtaining a certificate of competency as a deck cadet, individuals can rejoin a vessel to work as ship's navigation officers. Both deck cadets and navigation officers should have two main competency components. The first component is standard competencies, as established by IMO, which every deck cadet and navigation officer must have to adequately perform tasks on conventional vessels. These standard competencies include three domains: navigation, cargo handling and stowage, and controlling the operation of the ship and care for persons on board. The second component consists of additional competencies needed to adapt to the evolving maritime technology in the digital age. This component includes two domains: soft skills and information technology. Based on the research findings presented in Table 3 to 7, it can be concluded that all five domains, totaling 31 competencies, are essential for both deck cadets and navigation officers. These competencies enable them to effectively address the challenges of working on cargo vessels in the digital age. These conclusions are aligned with research conducted by Cicek et al. (2019), Jo, D'agostini, & Kang (2020), Wongpet & Moungpan (2021), Kipper et al. (2021), OCIMF, and Intertanko (2018).

The research findings demonstrate that the overall competency level of Thai deck cadets is high. However, it is positioned closer to the moderate level. Therefore, it is imperative to expedite the enhancement of competency levels to ensure that deck cadets have competitive competencies and skills in the global maritime workforce. In general, it was found that deck cadets have a high competency level in the navigation domain, cargo handling and stowage domain, controlling the operation of the ship and care for persons on board domain, and soft skills domain. Additionally, their competency level in the information technology domain is categorized as moderate. The detailed outcomes of the research in each domain are explained as follows:

In the first domain, navigation is an area where deck cadets can predominantly show a high level of competency. However, even though they can exhibit this capability at a high level, it remains within a relatively low range of high proficiency, bordering on the moderate level. Additionally, two competencies are found in the moderate level: use the IMO standard marine communication phrases and use English in written and oral form. These skills are crucial for effective international communication, as deck cadets need to communicate with colleagues from different countries, interact with other ships, and engage with foreign port authorities and other stakeholders during their duties. Another competency is transmit and receive information by visual signaling, which is vital for transmitting messages over long distances, especially during emergencies or when radio communication is compromised. This competency ensures safe navigation, adherence to regulations,

and effective communication with other vessels and shore facilities. Considering this, educational institutions and training centers for deck cadets should expedite training efforts to enhance both knowledge and skills to ensure higher competency levels.

In the second domain, cargo handling and stowage, it is found that the competency level within this domain is at a high level. Educational institutions and training centers for deck cadets should either maintain this level or elevate it to the highest competency.

In the third domain, controlling the operation of the ship and care for persons on board, it is observed that almost all competencies are at a high level, except for one competency which is at a moderate level. This competency is apply medical first aid onboard ship. This competency becomes crucial for future duties when performing tasks on the ship, as most cargo vessels generally do not have a doctor on board. Therefore, Navigation officers need to have basic medical skills for various emergencies, such as administering medication, stitching wounds, and understanding the process of transferring crew members for medical treatment at the nearest healthcare facility in different countries. Educational institutions and training centers for deck cadets should expedite efforts to enhance learning and training in this area to elevate competency levels.

In the fourth domain, Soft Skills, the research findings reveal that the majority of competencies are at a high level, except for three competencies that are assessed as being at a moderate level. These competencies are 'Situation Awareness', 'Decision Making', and 'Leadership and Managerial Skills'. Situation awareness is a vital competency for ship navigation', enabling crew members to understand their surroundings, anticipate risks, and make informed decisions. By interpreting data from radar, GPS, charts, and visual observations, they can avoid collisions, navigate challenging conditions, and respond effectively to emergencies. Decision-making competency is crucial for ship operations, empowering crew members to select optimal courses of action in complex and dynamic maritime environments. Evaluating factors like weather, navigation data, and safety protocols allows for informed decisions, preventing accidents, ensuring efficient voyage planning, and responding effectively to emergencies. Leadership and managerial skills are also fundamental in maritime contexts to ensure the effective coordination and operation of a ship. Competent leaders guide crew members in adhering to safety protocols, managing resources, and responding to emergencies. Their ability to communicate, make quick decisions, and promote a cohesive team atmosphere is vital for smooth navigation, crew morale, and the overall success of maritime missions. Educational institutions and training centers for deck cadets should expedite efforts to enhance these competencies through focused learning and training, including curriculum development, to elevate the proficiency of all three competencies.

In the final domain, Information Technology, the research findings indicate that the overall competency level is in the moderate range, with all competencies within this domain also being at a moderate level. Given that the maritime industry is moving into the digital age, competencies in this domain are of utmost importance. It is imperative for deck cadets to possess competencies at a high or even the highest level to align their knowledge and skills with the evolving demands of the maritime transportation sector. This adjustment is essential to meet the needs of the global workforce market and to adapt to the transition from conventional vessel operations to the digital age of maritime navigation. Educational institutions and training centers for deck cadets should accelerate efforts to enhance and develop their curriculum to accommodate these ongoing changes.

5.3 Recommendation

Future research endeavors can extend this work to explore the competencies of engine cadets. This is crucial due to the increasing importance of engine cadet competencies as maritime technology advances. Engine officers are required to navigate intricate digital systems, automation, and remote monitoring. Investigating the competency levels of engine cadets in this context ensures their proficiency in effectively managing and adapting to these technological advancements. This, in turn, enhances operational efficiency and ensures the safety of ships in the digital age.

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