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Factors Influencing the Improvement of Indonesian Seafarers' Competency Quality

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Abstract: This study examines key factors that influence the improvement of Indonesian seafarers' competency. Using a quantitative approach, the research focuses on three main areas: training and education, training infrastructure, and technology implementation. A random sampling method was used to gather data from 100 respondents, including active seafarers, new graduates, maritime instructors, and HR managers from shipping companies. Data was collected through questionnaires and analyzed using Multiple Linear Regression with SPSS 25. The results show that all three factors significantly impact the quality of seafarers' competencies. Improvements in training and education, infrastructure, and technology are essential for enhancing skills and ensuring safety at sea. Collaboration between the government, training institutions, and companies is crucial to achieving these improvements and boosting Indonesia's maritime competitiveness globally.

Keywords: Seafarers' competency, training, infrastructure, technology, maritime industry, Indonesia.

INTRODUCTION

The quality of seafarers' competence is a key factor in ensuring maritime safety, operational efficiency, and global competitiveness (ICS, 2023). Competent seafarers can ensure that ships are operated in compliance with international safety standards, reducing the risk of accidents and increasing the trust of shipowners and maritime service users. The International Maritime Organization (IMO) sets minimum standards for seafarers' competence through the STCW (Standards of Training, Certification, and Watchkeeping), which must be met by all member countries, including Indonesia. However, despite adopting these standards, the competence of Indonesian seafarers is still considered to need improvement, especially in the face of increasingly fierce global workforce competition (R. Herlan guntoro, Andesvan Gumay, 2023) The global workforce of seafarers employed on merchant vessels engaged in international trade is estimated to total 1,892,720 seafarers. This group is comprised of 857,540 officers and 1,035,180 ratings (Maritime, 2021). The top five

countries providing the highest number of seafarers are the Philippines, the Russian Federation, Indonesia, China, and India (show in table 1). Indonesia's seafarers are 1,522,086

Table 1. Five largest seafarer-supplying countries

	All Seafarers	Officers	Ratings
1	Philippines	Philippines	Philippines
2	Russian Federation	Russian Federation	Russian Federation
3	Indonesia	China	Indonesia
4	China	India	China
5	India	Indonesia	India

Source:(Maritime, 2021)

One of the main challenges faced is the disparity between the competence of seafarers produced by maritime educational institutions and the needs of the industry (Widiatmaka et al., 2022). This is reflected in a report by the Ministry of Transportation (2020), which stated that only about 60% of Indonesian seafarers passed the international competency test in 2019. Additionally, a survey by the Indonesian National Shipowners' Association (INSA) indicated that many shipping companies still have to provide additional training for new seafarers, as the competencies acquired during formal education often fall short of expected standards.

To enhance the competence of seafarers, an integrated effort is needed, involving several key factors. These include the quality of training and education provided, the availability of adequate training facilities and infrastructure, and the application of technology in the training and maritime operational processes. These three factors are interconnected and play a crucial role in shaping the quality of seafarers' competence.

Training and Education form the foundational basis for developing seafarers' competence. High-quality training, including a relevant curriculum, effective teaching methods, and qualified instructors, equips seafarers with the knowledge and skills necessary to perform their duties on board. According to Amrullah, (2023) structured and continuous training has a significant impact on enhancing both technical and non-technical competencies.

Training Facilities and Infrastructure also play a critical role in supporting an effective learning process. Facilities such as simulators, laboratories, and adequate classrooms allow seafarers to practice technical skills and gain a better understanding of real-world situations they may encounter. A study by Dewi et al. (2020), found that the availability of adequate training facilities at maritime education institutions in Indonesia remains uneven (Sangganagara, 2021), resulting in varying graduate quality across institutions. This underscores the importance of investing in the development of training infrastructure to ensure that all seafarers have equal access to quality learning facilities.

In addition, the Implementation of Technology in maritime training and operations is an essential factor that cannot be overlooked. The use of technology such as VR (Virtual Reality)-based simulation, e-learning, and digital training management systems enhances the effectiveness and efficiency of the learning process, enabling seafarers to access training materials anytime and anywhere. Research conducted by Makransky & Klingenberg, (2022) indicates that technology-based training not only improves seafarers' understanding of standard operating procedures but also helps develop decision-making skills in emergency situations.

Therefore, to improve the quality of Indonesian seafarers' competencies, a holistic approach is needed, considering these three factors simultaneously. This is why the researcher has chosen the title "Factors Influencing the Improvement of Indonesian Seafarers' Competency Quality."

Literature review

Training & Education

As mandated by the STCW 1978 Convention, 2010 Amendments, seafarers are expected to gain sufficient academic knowledge and sailing experience before advancing to the next level of training. Maritime Education and Training Institutions (METs) play a critical role in this process. The assessment of instructional methods in METs is essential to ensure alignment with international conventions (Purwantomo et al., 2021). Both METs and maritime administrations must ensure that seafarers receive the best possible training to competently perform their duties.

According to Boonadir et al., (2020) In addition to education and training, another critical component is the comprehensive application of the Standards of Training, Certification, and Watchkeeping (STCW) Convention 1978/2010, which must be reflected in the curriculum and training frameworks of maritime educational institutions .

Training Infrastructure

Facilities and infrastructure are essential tools supporting the success of efforts aimed at improving academic quality. The availability of facilities and infrastructure should be assessed not only in terms of quantity but also in terms of quality (Safingudin, 2020).
Simulator facilities serve as flagship resources equipped with the latest technology. Some of these include the Full Mission Ship Bridge Simulator, which replicates the working systems and equipment on a ship’s bridge, offering an experience akin to being on board. The Full Mission Ship Engine Simulator mirrors the conditions, workflow, and environment of a ship's engine room. The ARPA (Automatic Radar Plotting Aid) Simulator is used for navigation in non-visual conditions, relying solely on radar observation. The ECDIS (Electronic Chart Display and Information System) is a computer-based navigation system compliant with IMO regulations. These and various other simulators enhance the maritime training experience.

Laboratories and simulators are utilized as facilities to refine the skills of training participants in accordance with the competencies that have been studied, through competency evaluations that include written tests/theory as well as observational techniques (Suharso et al., 2019). In the Train the Simulator Trainer and Assessor, IMO Model Course 6.10, simulators are employed as tools to assess participants' competencies both theoretically and through comprehensive practical assessments conducted by academics or instructors. Therefore, simulators serve as a practical means in line with competency testing methods, simulating the operation of machinery systems on board vessels in a manner that resembles actual processes, thus allowing them to be used for comprehensive examinations.

Technology Implementation

Technology plays a significant role in advancing the maritime sector. In Indonesia, technology has become the foundation for research and innovation in the maritime industry, supporting its growth and development. Thanks to technological advancements, Indonesia has successfully modernized its maritime infrastructure, enhanced the efficiency of sea transportation, and improved port operations, which has positively impacted national economic growth(Aris Sarjito, 2023).

According to Wibowo Wibowo et al. (2021) in their research (Aris Sarjito, 2023), technology has enabled Indonesia to develop capabilities in vessel tracking, improve weather prediction, and enhance safety and security in maritime operations. One notable example of significant technological application in Indonesia's maritime industry is the development of the Sea Traffic Control and Surveillance System (STCS). This system employs technologies such as radar and the Automatic Identification System (AIS) to monitor and regulate vessel traffic in Indonesian waters. The implementation of STCS has improved maritime safety, security, and efficiency, thereby attracting more investors to the industry. Furthermore,

technology has opened new opportunities for research in various fields such as oceanography, marine biology, and marine geology, helping to enhance our understanding of marine ecosystems and their economic potential (Aprilia, 2023).

Quality of Indonesian Seafarers' Competence

Interest in personal competency development is a crucial factor for enhancing the quality of human resources, including for the profession of seafarers. This interest in development has a strong correlation with individuals' job satisfaction levels (Rahman et al., 2021).

This factor refers to the set of competencies possessed by an individual, which stems from skills, training, and experience, enabling them to perform their duties professionally to achieve the objectives of being a crew member. These factors include loyalty, work performance, responsibility, adherence, honesty, cooperation, creativity, initiative, and leadership. This condition is essential for improving work productivity, characterized by the effectiveness and efficiency in task execution (Candra Oktyasari Putri et al., 2023).

METHOD

This study employs a quantitative approach, which, according Ali et al., (2022), is defined as research aimed at measuring and developing relationships among research variables, serving as a method to obtain answers to research hypotheses based on observable characteristics. Population in this article are Active sailors, new graduate sailors, maritime instructors and lecturers, and HR managers in shipping companies. In this study, the sampling method used is probability sampling, also known as probability sampling. Random sampling is a technique for sample selection in which the population is very large, allowing the researcher to select 100 members randomly from the total population as the sample. The sampling technique in this study uses the Slovin formula with a margin of error (e) of 0.1 or 10%, applied to a large population. Based on this calculation, the sample size obtained is 100 respondents (Sugiyono, 2011). This research employs primary data through the distribution of questionnaires via Google Forms, complemented by secondary data obtained from literature reviews, such as journals, articles, reports, documents, books, and other reading materials. The study utilizes Multiple Linear Regression Analysis techniques for hypothesis testing using SPSS 25.

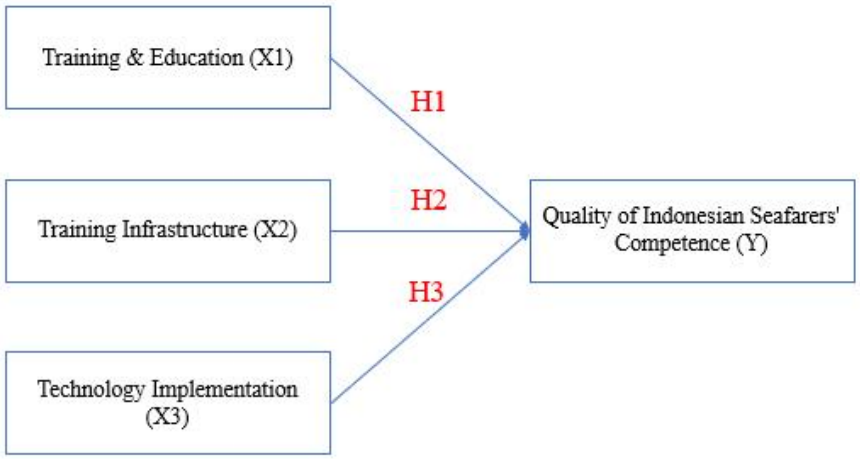

Fig. 1. Research Framework

RESULTS AND DISCUSSION

Validity Test

Table 1 Validity Testing

No	Variable	Indicators	r value	r table	Remarks
1	Training & Education (X1)	1. Indicator 1	0.916	0,197	VALID
		2. Indicator 2	0.920	0,197	VALID
		3. Indicator 3	0.884	0,197	VALID
		4. Indicator 4	0.893	0,197	VALID
2	Training Infrastructure (X2)	1. Indicator 1	0.863	0,197	VALID
		2. Indicator 2	0.888	0,197	VALID
		3. Indicator 3	0.876	0,197	VALID
		4. Indicator 4	0.866	0,197	VALID
3	Technology Implementation (X3)	1. Indicator 1	0.912	0,197	VALID
		2. Indicator 2	0.920	0,197	VALID
		3. Indicator 3	0.917	0,197	VALID
		4. Indicator 4	0.911	0,197	VALID
4	Quality of Indonesian Seafarers' Competence (Y)	1. Indicator 1	0.839	0,197	VALID
		2. Indicator 2	0.825	0,197	VALID
		3. Indicator 3	0.835	0,197	VALID
		4. Indicator 4	0.843	0,197	VALID
		5. Indicator 5	0.857	0,197	VALID
		6. Indicator 6	0.781	0,197	VALID

Table 1 shows that all indicators used have a calculated r value greater than the table r value (0.197). This confirms that all indicators are valid and suitable for use as measurement tools for the variables in this study.

Reliability Test

Table 2 Reliability Testing

No	Variable	Items	R value	Remarks
1	Training & Education (X1)	4	0.924	Reliable
2	Training Infrastructure (X2)	4	0.896	Reliable
3	Technology Implementation (X3)	4	0.911	Reliable
4	Quality of Indonesian Seafarers' Competence (Y)	6	0.909	Reliable

Based on the results displayed in the table, all variables show a Cronbach's Alpha value greater than 0.70. Therefore, the indicators for the variables of service quality, information quality, accessibility, facilities (supporting resources), and passenger satisfaction are deemed reliable and suitable for use as measurement tools in this research.

Normality Test

The purpose of the normality test is to ensure that the data used in the regression model follow a normal distribution or are approximately normal, as recommended by Ghozali (2016:154). To evaluate whether the data in the regression model adhere to a normal distribution, the non-parametric Kolmogorov-Smirnov (K-S) statistical test can be employed.

One-Sample Kolmogorov-Smirnov Test

			Unstandardized Residual
N			100
Normal Parameters[a,b]	Mean		.0000000
	Std. Deviation		2.13992774
Most Extreme Differences	Absolute		.078
	Positive		.059
	Negative		-.078
Test Statistic			.078
Asymp. Sig. (2-tailed)[c]			.142
Monte Carlo Sig. (2-tailed)[d]	Sig.		.141
	99% Confidence Interval	Lower Bound	.132
		Upper Bound	.150

a. Test distribution is Normal.

b. Calculated from data.

c. Lilliefors Significance Correction.

d. Lilliefors' method based on 10000 Monte Carlo samples with starting seed 2000000.

Fig. 2. Normality Testing

Based on the table above, it can be concluded that the variables tested—service quality, information quality, accessibility, facilities (supporting resources), and passenger satisfaction—meet the criteria for normal distribution. This is evidenced by an Asymp. Sig value of 0.142, which is greater than 0.05. In other words, the data for these variables exhibit a normal distribution, in accordance with the criteria established in the normality test.

Multicollinearity test

The multicollinearity test aims to identify whether there is a correlation among the independent variables in the regression model.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	5.781	1.301		4.445	<.001		
	X1	.554	.073	.497	7.617	<.001	.785	1.274
	X2	.350	.082	.292	4.295	<.001	.722	1.386
	X3	.299	.071	.269	4.197	<.001	.816	1.225

a. Dependent Variable: Y

Fig. 3. Multicollinearity Testing

Based on the table above, the calculation of the Tolerance values indicates that all independent variables have values greater than or equal to 0.10, and the Variance Inflation Factor (VIF) values are less than or equal to 10. This demonstrates that there is no correlation among the independent variables. Therefore, the variables are considered suitable for use in the analysis.

Heteroscedasticity test

The heteroscedasticity test aims to check whether there is a difference in the variance of residuals across observations in the regression model.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.842	.800		3.553	<.001
	X1	.001	.045	.001	.012	.991
	X2	-.068	.050	-.160	-1.352	.179
	X3	-.010	.044	-.026	-.236	.814

a. Dependent Variable: RES_ABS

Fig. 4. Heteroscedasticity Test

Based on the table above, the results of the Glejser test indicate that the significance values for all independent variables are greater than 0.05. This suggests that there are no issues of heteroscedasticity in the data. Therefore, the data meets the criteria to be used in the research.

Multiple Linear Regression Analysis

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	5.781	1.301		4.445	<.001		
	X1	.554	.073	.497	7.617	<.001	.785	1.274
	X2	.350	.082	.292	4.295	<.001	.722	1.386
	X3	.299	.071	.269	4.197	<.001	.816	1.225

a. Dependent Variable: Y

Fig. 5. Multiple Linear Regression Analysis

Using the standard regression coefficient values, the linear equation generated from the multiple linear regression analysis is as follows:

$$Y = 5{,}781 + 0{,}497\ X1 + 0{,}292\ X2 + 0{,}269\ X3 + \varepsilon$$

Description: Y represents Quality of Indonesian Seafarers' Competence , X1 represents Training & Education, X2 represents Training Infrastructure and X3 represents Technology Implementation

Overall, all independent variables in this regression model demonstrate a positive relationship with the dependent variable, which is Quality of Indonesian Seafarers' Competence. This means that any improvement in the independent variables can contribute to an increase in passenger satisfaction.

T-test

The t-test aims to determine whether the independent variables— Training & Education (X1), Training Infrastructure (X2) and Technology Implementation (X3)—have a significant impact on the dependent variable, which is Quality of Indonesian Seafarers' Competence (Y), on an individual basis. If the significance value (p-value) of the tested variable is less than the established significance level (e.g., 0.05), then that variable can be considered to have a significant influence on customer satisfaction.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	5.781	1.301		4.445	<.001		
	X1	.554	.073	.497	7.617	<.001	.785	1.274
	X2	.350	.082	.292	4.295	<.001	.722	1.386
	X3	.299	.071	.269	4.197	<.001	.816	1.225

a. Dependent Variable: Y

Fig. 6. T test

The t-table value used in this analysis is 1.985 at a 5% significance level. Here are the testing results for each variable:

Training & Education (X1):

The test result shows a significance value of 0.001, which is lower than 0.05. The calculated t value is 7.717, which exceeds the t-table value of 1.985. This indicates that improvements in Training & Education tend to enhance Quality of Indonesian Seafarers' Competence.

Training Infrastructure (X2):

The test for Training Infrastructure reveals a significance value of 0.001, well below 0.05. The calculated t value is 4.295, which is higher than the t-table value of 1.985. This suggests that improvements in Training Infrastructure will contribute to increased Quality of Indonesian Seafarers' Competence.

Technology Implementation (X3):

The test for Technology Implementation reveals a significance value of 0.001, well below 0.05. The calculated t value is 4.197, which is higher than the t-table value of 1.985. This suggests that improvements in Technology Implementation will contribute to increased Quality of Indonesian Seafarers' Competence.

Relevant Coefficient

The relevant coefficient of determination for this model is measured by the Adjusted R Square (R^2). The results of this analysis provide information on how well the independent variables can explain the variation in the dependent variable. Below are the results of the Adjusted R^2 coefficient for this model:

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.824[a]	.679	.669	2.173

a. Predictors: (Constant), X3, X1, X2

b. Dependent Variable: Y

Fig. 7. Relevant Coefficient

Based on Figure 7, the obtained Adjusted R Square (R^2) value is 0.679. This indicates that 67.9% of the variation in Quality of Indonesian Seafarers' Competence (Y) can be explained by the independent variables, namely Training & Education (X1), Training Infrastructure (X2) and Technology Implementation (X3). Meanwhile, the remaining 32.1% is explained by other factors not included in this research model.

CONCLUSION

Overall, this research emphasizes the importance of three key factors—training and education, training infrastructure, and technology implementation—in enhancing the quality of Indonesian seafarers' competencies. Considering that the maritime industry is a highly

competitive and dynamic sector, greater attention to these three aspects will not only improve individual competencies but also strengthen Indonesia's competitiveness on the international stage.

Furthermore, the enhancement of seafarer competencies is expected to positively impact safety levels at sea. With better training and an understanding of the latest technologies, seafarers will be better prepared to handle emergency situations, reduce the risk of human error, and improve their response to hazardous conditions. This, in turn, will help mitigate the risk of maritime accidents, which is one of the main challenges in the sector.

Therefore, relevant stakeholders, including the government, training institutions, and shipping companies, need to collaborate on the development and implementation of improved programs across these three areas to create a safer and more efficient environment in Indonesia's maritime industry.

Implications

The findings of this study have significant implications for the Indonesian maritime industry. First, enhancing training and education, improving training infrastructure, and integrating modern technology are essential strategies for improving the competency of seafarers. These improvements will lead to higher safety standards and operational efficiency, which are critical in minimizing maritime accidents and improving performance at sea. Furthermore, by addressing these key areas, Indonesia's maritime workforce can become more competitive on the global stage, contributing to the country's overall economic growth and maritime leadership. Stakeholders, including the government, training institutions, and shipping companies, must collaborate to create robust training programs and invest in infrastructure that supports technological advancements. This collaboration is vital for sustainable development in the maritime sector and for preparing seafarers to meet future challenges in a rapidly evolving industry.

Research limitations

This study is subject to several limitations. First, the sample size of 100 respondents, although adequate for the research, may not fully capture the diverse perspectives of all Indonesian seafarers. A larger sample size could provide more generalized results. Second, the study primarily relies on self-reported data collected via questionnaires, which may be influenced by respondents' biases or limited understanding of the questions. Lastly, the research focuses on three specific factors—training and education, infrastructure, and technology implementation—without exploring other potential variables that may also affect seafarers' competencies, such as management practices or cultural influences. Future research should consider these additional variables and expand the scope to provide a more holistic view of the factors influencing seafarers' competency development.

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