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The Influence of English Language Competence, Digital Literacy, Grit, and Technostress on Ship Crew Performance Mediated by Human Capital Capability

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Abstract: Crew performance determines the safety and operational efficiency of shipping companies, yet human factors remain the dominant cause of maritime accidents. This study aims to analyze the influence of English language competence, digital literacy, grit, and technostress on crew performance, with human capital capability serving as a mediating variable. A quantitative approach was employed, utilizing a survey of 316 seafarers from shipping companies in Indonesia, and the data were analyzed using partial least squares structural equation modeling (PLS-SEM) via SmartPLS. The results indicate that: 1) English language competence has a positive and significant effect on human capital capability; 2) Digital literacy has a positive and significant effect on human capital capability; 3) Grit has a positive and significant effect on human capital capability; 4) Technostress does not have a significant effect on human capital capability; 5) English language competence does not have a significant effect on crew performance; 6) Digital literacy does not have a significant effect on crew performance; 7) Grit has a positive and significant effect on crew performance; 8) Technostress does not have a significant effect on crew performance; 9) Human capital capability has a positive and significant effect on crew performance; 10) Human capital capability fully mediates the effect of English language competence on crew performance; 11) Human capital capability fully mediates the effect of digital literacy on crew performance; 12) Human capital capability partially mediates the effect of grit on crew performance; 13) Human capital capability does not mediate the effect of technostress on crew performance. Shipping companies need to enhance crew performance by strengthening human capital capability through maritime English training, digital literacy development, and mental resilience building. The novelty of this study lies in examining human capital capability as a mediating mechanism among Indonesian seafarers.

Keywords: Crew Performance, Human Capital Capability, English Language Competence, Digital Literacy, Grit, Technostress.

INTRODUCTION

Background of the problem

Crew performance is a key determinant of maritime safety, delivery punctuality, and the business sustainability of shipping companies. As shipping serves as the backbone of global trade, the availability of competent crew members is a strategic necessity for the industry (Syaban & Mokodompit, 2024). In the study of work behavior, performance encompasses task performance the completion of core work and contextual performance behavior that supports the work environment (Patmawati et al., 2025). In the context of seafarers, these two dimensions are reflected in the ability to perform watchkeeping duties, operate equipment, and work collaboratively in a team within an isolated environment characterized by long working hours (Kundori & Pranyoto, 2023). All these factors are presumed to operate through human capital capability specifically, the knowledge, skills, and abilities inherent in individuals that form the foundation of their performance (Indriyani & Akbar, 2026).

The importance of this study is evident from the development of the shipping industry and the supply of seafarers. The national merchant fleet grew from approximately 6,041 vessels in 2005 to over 24,046 vessels in 2016 following the implementation of the cabotage principle (INSA, 2023). Globally, the supply of STCW-certified seafarers increased from 1,647,500 in 2015 to 1,892,720 in 2021 and 2,565,580 in 2026, while demand has risen by approximately 35% since 2021 (International Chamber of Shipping, 2026). Indonesia is among the top five suppliers of seafarers, with 1.6 million seafarers by 2026 (Direktorat Jenderal Perhubungan Laut, 2026). However, the growth in that number does not yet guarantee the quality of performance.

Of the 27 maritime accident cases investigated by the National Transportation Safety Committee (KNKT) between 2007 and 2011, approximately 41% were caused by human factors, with some studies indicating that this contribution exceeds 80% (Kendek et al., 2022). Supporting data are presented in Table 1 and Figure 1 below:

Table 1. Indicators of Commercial Fleet, Seafarer Supply, and Ship Accidents

Indicator	Period	Value	Source
National commercial fleet (units)	2005 dan 2023	± 6.000 dan > 24.000	(INSA, 2023)
Global seafarer supply: officers / ratings	2026	1.647.500/1.892.720	(International Chamber of Shipping, 2026)
Indonesian seafarers: officers / ratings	2026	1.600.000	(Direktorat Jenderal Perhubungan Laut, 2026)
Ship accident investigated by the KNKT caused by human factors	2007–2011	41% (dari 27 kasus)	(Kendek et al., 2022)

Source: (INSA, 2023), (International Chamber of Shipping, 2026), (Direktorat Jenderal Perhubungan Laut, 2026), (Kendek et al., 2022)

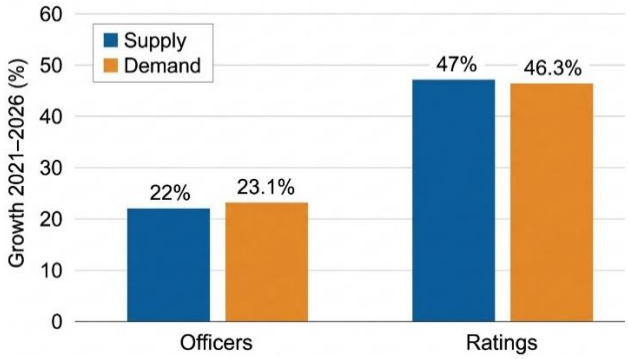


Figure 1. Growth of Global STCW Seafarer Supply and Demand, 2021–2026
Source: (International Chamber of Shipping, 2026), (INSA, 2023)

Figure 1 shows that the rise in demand for seafarers since 2021 has largely kept pace with the increase in supply, particularly regarding ratings (46.3% versus 47%) and officers (23.1% versus 22%). This situation indicates that shipping companies are competing to recruit and retain crew members; consequently, the challenge lies not only in numbers but also in the capabilities and performance of the recruited seafarers. Meanwhile, the digitalization of the shipping industry is creating new pressures: a survey of 411 ship officers in Turkey revealed moderate levels of "technostress" related to workload and technological uncertainty (Bayrak & Muslu, 2025). This type of pressure is relevant for Indonesian seafarers working on vessels with increasingly diverse digital equipment.

A major challenge facing shipping companies is suboptimal crew performance, as evidenced by the significant role human factors play in maritime accidents. The consequences include risks to human life, damage to vessels and cargo, marine pollution, voyage delays, and a decline in the company's reputation and competitiveness (Yin et al., 2025). The underlying causes are multifaceted; for instance, limited English proficiency can lead to misunderstandings regarding orders and communication among the crew (I. M. Dewi, 2023). Low digital literacy hinders the utilization of digital systems on board ships. Low endurance and perseverance make it difficult for seafarers to cope with long-term work at sea (Gustian & Evri, 2026).

The research gap lies in the limited number of studies that simultaneously examine the impact of English language proficiency, digital literacy, grit, and technostress on the performance of ship crew members through the lens of human capital capability. Previous research on seafarers has largely focused on job satisfaction, work-related stress, and remuneration (Song et al., 2021), ...with a relatively small sample. Research on technostress among seafarers still focuses on technostress levels and demographic factors, rather than its impact on performance (Bayrak & Muslu, 2025). Meanwhile, research on grit and digital literacy has generally been conducted in non-maritime sectors; thus, the findings may not necessarily apply to seafarers working on ships, where they face isolation and long working hours (Pletschke, 2024). A limitation of previous research also lies in the examination of direct effects without mediating mechanisms, thereby failing to explain how individual characteristics translate into performance.

This study focuses on the impact of English language competence, digital literacy, grit, and technostress on the performance of ship crew members, with human capital capability serving as a mediating variable. The study targets seafarers employed by shipping companies in Indonesia, involving 316 respondents. It addresses a research gap regarding the lack of empirical evidence concerning the role of human capital capability as a mechanism bridging the influence of these four antecedents on performance. This research is crucial because the human factor remains a dominant element in maritime accidents, the digitalization of the

shipping industry increases demands for competence and work-related pressure, and Indonesian seafarers constitute a vital part of the global maritime workforce supply chain.

Based on this background, the research questions are formulated as follows: 1) How does English language competence affect human capital capability among seafarers in Indonesian shipping companies?; 2) How does digital literacy affect human capital capability among seafarers in Indonesian shipping companies?; 3) How does grit affect human capital capability among seafarers in Indonesian shipping companies?; 4) How does technostress affect human capital capability among seafarers in Indonesian shipping companies?; 5) How does English language competence affect the performance of ship crew members in Indonesian shipping companies?; 6) How does digital literacy affect the performance of ship crew members in Indonesian shipping companies?; 7) How does grit affect the performance of ship crew members in Indonesian shipping companies?; 8) How does technostress affect the performance of ship crew members in Indonesian shipping companies?; 9) How does human capital capability affect the performance of ship crew members in Indonesian shipping companies?; 10) How does English language competence affect the performance of ship crew members when mediated by human capital capability in Indonesian shipping companies?; 11) How does digital literacy affect the performance of ship crew members when mediated by human capital capability in Indonesian shipping companies?; 12) How does grit affect the performance of ship crew members when mediated by human capital capability in Indonesian shipping companies?; 13) How does technostress affect the performance of ship crew members, mediated by human capital capability, among seafarers in Indonesian shipping companies?.

METHOD

This study employs an explanatory quantitative approach to examine causal relationships and mediating effects among variables. The study population consists of crew members working for shipping companies in Indonesia. The sample comprises 316 respondents selected via non-probability sampling specifically purposive sampling based on the criteria of active crew members with seafaring experience (Susanto et al., 2024).

Data collection was conducted by distributing structured questionnaires utilizing a 1–5 Likert scale. Data analysis was performed using the Partial Least Squares-based Structural Equation Modeling (SEM-PLS) technique with SmartPLS 4.0 software. The analysis stages involved evaluating the outer model (convergent validity testing via outer loadings and AVE, as well as reliability testing via Cronbach's Alpha and Composite Reliability) and subsequently evaluating the inner model (coefficient of determination/R-square, t-statistics, and p-values) to test hypotheses regarding direct and indirect effects (Hair et al., 2024).

RESULTS AND DISCUSSION

Results

Crew Performance

Crew performance refers to the level of work achievement demonstrated by crew members in carrying out operational duties and responsibilities on board, in accordance with safety standards, work procedures, competency requirements, timeliness, and maritime operational demands. Crew performance reflects not only the ability to complete tasks effectively and efficiently but also the capacity to execute safety procedures, make decisions in operational situations, and collaborate with other crew members (Putra et al., 2026).

The indicators or dimensions comprising the ship crew performance construct include: 1) Quality of Work Output: The level of precision and reliability demonstrated by the crew in executing technical and administrative shipboard tasks, thereby minimizing errors; 2) Work Productivity: The crew's ability to complete tasks and responsibilities effectively and efficiently meeting established targets and deadlines without compromising work quality; and

3) Work Responsibility: The crew's ability to perform duties within their scope of authority, adhere to procedures, maintain safety, and take accountability for work outcomes and the ship's operational condition (Rachman et al., 2025).

The construct of crew performance is relevant to the research conducted or studied by: (Wibowo et al., 2025), (Putra et al., 2026).

Human Capital Capability

Human Capital Capability refers to the ability of organizations and individuals to optimize human knowledge, skills, experience, competencies, and capacities in order to generate value and enhance the achievement of organizational goals (Leoni, 2025).

The indicators or dimensions comprising the human capital capability construct include: 1) Maritime Technical Knowledge: Mastery of theories, concepts, and in-depth understanding regarding navigation systems, vessel operations, and maritime operational dynamics; 2) Practical Skills: The ability to apply technical knowledge to problem-solving, equipment operation, and daily operational tasks on board; and 3) Adaptability: The ability of crew members to adjust to changing sailing conditions, work procedures, technologies, and evolving job demands (Islam & Amin, 2022).

The construct of human capital capability is relevant to the research conducted by: (Hake & Mate, 2024), (Leoni, 2025).

English Language Competence

English language competence refers to a crew member's ability to understand and use English effectively in both spoken and written communication, in accordance with job requirements and the maritime operational environment. This competence encompasses the ability to understand instructions, convey information, and communicate with other crew members or external parties (Khoiruman & Irawan, 2026).

The indicators or dimensions comprising the English language competence construct include: 1) English Language Communication: The ability of crew members to convey information, instructions, and reports, as well as to communicate verbally in English clearly and accurately; 2) Multicultural Interaction Fluency: The ability to coordinate and clearly convey work instructions in English within a multinational crew environment; and 3) Understanding of Technical Documents and Manuals: The ability to read, comprehend, and interpret equipment manuals, navigation charts, and maritime regulatory documents written in English (Simanjuntak et al., 2025).

The construct of English language competence is relevant to research conducted or researched by: (Khoiruman & Irawan, 2026), (Purwantini et al., 2026).

Digital Literacy

Digital literacy is the ability of crew members to access, understand, use, evaluate, and manage information and digital technology effectively, safely, and responsibly in support of their work. In an increasingly digitized maritime environment, digital literacy encompasses the ability to use shipboard information systems and digital devices, as well as to obtain and evaluate relevant information (J. Li et al., 2024).

The indicators or dimensions comprising the digital literacy construct include: 1) Digital Device Operation Capability: Practical skills in operating modern digital systems and applications on board, such as ECDIS, integrated radar, and voyage management software; 2) Digital Information Management Capability: The ability to search for, comprehend, evaluate, utilize, and manage digital information relevant to maritime operational needs; and 3) Digital Security and Ethics: An understanding of basic cybersecurity on board, as well as awareness

regarding the preservation of the confidentiality and integrity of vessel operational data (Scanlan et al., 2023).

The construct of digital literacy is relevant to research conducted or researched by: (J. Li et al., 2024), (Kardiono et al., 2025).

Grit

Grit is a psychological characteristic that reflects an individual's perseverance and consistency in maintaining effort and commitment to long-term goals, despite facing difficulties, pressure, failure, or various obstacles (Apriliana et al., 2023).

The indicators or dimensions comprising the grit construct include: 1) Persistence in Effort: The ability of crew members to continue striving to complete tasks despite facing difficulties, pressure, fatigue, or obstacles during duty; 2) Consistency of Interest: The ability to remain focused and maintain commitment to maritime career goals over the long term, despite the monotony or routine nature of work at sea; and 3) Resilience in the Face of Obstacles: The ability to bounce back and remain calm when encountering failure, technical issues, or emergencies on board (Dijksma et al., 2022).

The grit construct is relevant to research conducted or researched by: (Cojocaru & Deliu, 2024), (Apriliana et al., 2023).

Technostress

Technostress is a state of pressure, tension, or stress experienced by an individual resulting from the use, demands, complexity, or changes associated with technology used in the workplace, or an inability to adapt to it (X. Li et al., 2025).

The indicators or dimensions comprising the technostress construct include: 1) Technostress due to Technological Change: The level of pressure arising from changes, updates, or the implementation of new technologies that require crew members to continuously learn and adapt; 2) Technostress due to Complexity: The level of pressure experienced by crew members when the technology or digital systems in use are perceived as overly complex, requiring additional skills or knowledge; and 3) Technostress due to Technological Overload: The level of pressure experienced due to demands for intensive technology use, the volume of digital information, or the obligation to constantly respond to digital systems and devices while working (Lagdami & Stana, 2025).

The technostress construct is relevant to research conducted or researched by: (Bayrak & Muslu, 2025), (X. Li et al., 2025).

Respondent Characteristics

The table below presents the characteristics of the respondents in this study:

Table 2. Respondents' Gender

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	304	96.2	96.2	96.2
	Female	12	3.8	3.8	100.0
	Total	316	100.0	100.0	

Table 3. Duration of Work as a Seafarer

Length of Service as a Seafarer					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 = <5 year	94	29.7	29.7	29.7
	2 = 6-10 year	69	21.8	21.8	51.6
	3 = 11-15 year	40	12.7	12.7	64.2
	4 = 16-20 year	47	14.9	14.9	79.1

> 20 year	66	20.9	20.9	100.0
Total	316	100.0	100.0	

Table 4. Respondents' Highest Level of Education

Last education					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	53	16.8	16.8	16.8
	2	124	39.2	39.2	56.0
	3	24	7.6	7.6	63.6
	4	115	36.4	36.4	100.0
	Total	316	100.0	100.0	

Tables 2, 3, and 4 present the demographic profile and characteristics of the 316 crew member respondents who constituted the study sample.

Outer Loading Test

The outer loading test is intended to test the convergent validity of research items. According to (Ghozali & Latan, 2020), convergent validity is assessed based on outer loadings and AVE values. The cutoff value for outer loadings (factor loadings) is 0.7; however, values between 0.5 and 0.7 are still considered acceptable for convergent validity in early-stage research.

Table 5. Outer Loadings

Indicator	English Language Competence (X1)	Digital Literacy (X2)	Grit (X3)	Technostress (X4)	Human Capital Capability (Z)	Crew Performarmance (Y)	Information
KBI1	0,883						Valid (Baik)
KBI2	0,908						Valid (Baik)
KBI3	0,900						Valid (Baik)
KBI4	0,890						Valid (Baik)
KBI5	0,900						Valid (Baik)
LDG1		0,843					Valid (Baik)
LDG2		0,828					Valid (Baik)
LDG3		0,814					Valid (Baik)
LDG4		0,832					Valid (Baik)
LDG5		0,838					Valid (Baik)
LDG6		0,881					Valid (Baik)
GRT1			0,752				Valid (Baik)
GRT2			0,847				Valid (Baik)
GRT3			0,876				Valid (Baik)
GRT4			0,882				Valid (Baik)
GRT5			0,792				Valid (Baik)
TNS1				0,647			Valid (Baik)
TNS2				0,606			Valid (Baik)
TNS3				0,627			Valid (Baik)
TNS4				0,664			Valid (Baik)
TNS5				0,984			Valid (Baik)
HCC1					0,887		Valid (Baik)
HCC2					0,899		Valid (Baik)
HCC3					0,858		Valid (Baik)
HCC4					0,896		Valid (Baik)
HCC5					0,881		Valid (Baik)
HCC6					0,881		Valid (Baik)
HCC7					0,851		Valid (Baik)
KAK1						0,818	Valid (Baik)
KAK2						0,851	Valid (Baik)
KAK3						0,866	Valid (Baik)
KAK4						0,794	Valid (Baik)

KAK5	0,882	Valid (Baik)
KAK6	0,843	Valid (Baik)

All constructs passed the outer loadings test, as shown in Table 5, because the outer loading values for each construct exceeded 0.5 (0.7).

AVE Test

The Average Variance Extracted (AVE) test aims to measure the level of convergent validity at the variable or construct level. This test ensures that a variable is capable of explaining the majority of the variance of its constituent indicators. The established criterion is an AVE value greater than 0.5, indicating that the construct can explain at least 50% of the variance of its indicators.

Table 6. AVE Test Results

Variable	AVE	Critical Value	Information
English Language Competence (X1)	0,803	> 0,5	Valid / Meets the AVE value
Digital Literacy (X2)	0,705	> 0,5	Valid / Meets the AVE value
Grit (X3)	0,691	> 0,5	Valid / Meets the AVE value
Technostress (X4)	0,518	> 0,5	Valid / Meets the AVE value
Human Capital Capability (Z)	0,773	> 0,5	Valid / Meets the AVE value
Crew Performance (Y)	0,710	> 0,5	Valid / Meets the AVE value

All variables have AVE values above the critical threshold of 0.50, indicating that each construct meets the validity criteria, according to the AVE results shown in Table 6.

Cronbach's Alpha Test

The variable evaluation criteria indicate that if the Cronbach's alpha value for a given variable exceeds 0.7, that variable can be considered reliable (M. Dewi, 2024).

Table 7. Cronbach's Alpha

Variable	Cronbach's Alpha	Rule of Thumb	Result
English Language Competence (X1)	0,939	>0.7	Meeting Reliability Test Requirements
Digital Literacy (X2)	0,916	>0.7	Meeting Reliability Test Requirements
Grit (X3)	0,887	>0.7	Meeting Reliability Test Requirements
Technostress (X4)	0,903	>0.7	Meeting Reliability Test Requirements
Human Capital Capability (Z)	0,951	>0.7	Meeting Reliability Test Requirements
Crew Performance (Y)	0,918	>0.7	Meeting Reliability Test Requirements

Based on the Cronbach's alpha analysis presented in Table 7, all research constructs yielded values exceeding 0.70, indicating a very high level of reliability for each construct.

Composite Reliability Test

The Composite Reliability test aims to measure the internal consistency and reliability of the measurement instruments for each latent construct. Compared to Cronbach's Alpha, Composite Reliability is considered more accurate in the SEM-PLS approach because it does not assume that all indicators possess equal loading factor weights. The reference threshold (rule of thumb) is a value > 0.70.

Table 8. Composite Reliability

Variabel	Composite Reliability	Rule of Thumb	Result
English Language Competence (X1)	0,953	>0.7	Meeting Reliability Test Requirements
Digital Literacy (X2)	0,935	>0.7	Meeting Reliability Test Requirements

Grit (X3)	0,918	>0.7	Meeting Reliability Test Requirements
Technostress (X4)	0,838	>0.7	Meeting Reliability Test Requirements
Human Capital Capability (Z)	0,960	>0.7	Meeting Reliability Test Requirements
Crew Performance (Y)	0,936	>0.7	Meeting Reliability Test Requirements

Based on the composite reliability results presented in Table 8, all constructs exhibit values greater than 0.70, indicating that each construct in the model possesses excellent composite reliability, ranging from high to very high.

Coefficient of Determination (R-Square)

The Coefficient of Determination (R^2) is used to measure the ability of exogenous variables to explain the variation in endogenous variables within the research model.

Table 9. Coefficient of Determination

Endogenous Variable	R-square	R-square Adjusted	Category
Human Capital Capability (Z)	0,694	0,690	Moderate
Crew Performance (Y)	0,710	0,706	Moderate

The test results in Table X show that the R^2 value for the Human Capital Capability variable is 0.694 (adjusted R^2 of 0.690); this indicates that Maritime English Competence, Digital Literacy, Grit, and Technostress collectively explain 69.4% of the variation in Human Capital Capability, while the remaining 30.6% is explained by factors outside the research model. This R^2 value falls into the moderate category, bordering on substantial. Furthermore, the R^2 value for the Crew Performance variable is 0.710 (adjusted R^2 of 0.706), meaning that Maritime English Competence, Digital Literacy, Grit, Technostress, and Human Capital Capability collectively explain 71.0% of the variation in Crew Performance; this result is classified as moderate, bordering on the substantial (strong) category. These findings indicate that the developed research model possesses good explanatory power regarding both endogenous variables.

Inner Model

This structural model test aims to identify relationships or impacts between constructs, significance values, and R-squared values.

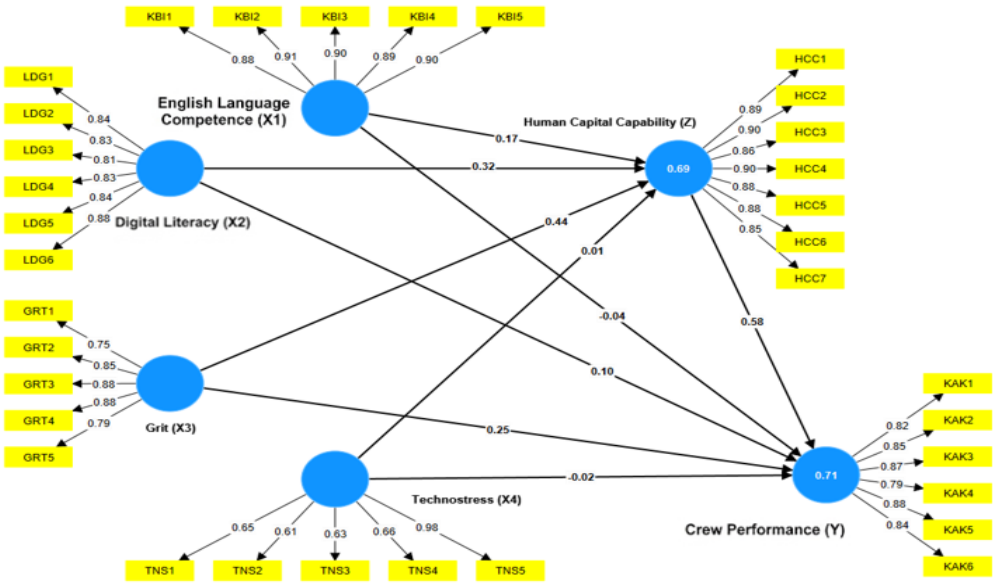


Figure 2. Inner Model

Source: SEM SmartPLS, 2026

Figure 2 presents the structural path diagram (Inner Model) resulting from SmartPLS 4.0 calculations. The figure displays outer loading values exceeding 0.5 for each indicator, as well as the path coefficients between variables and the coefficient of determination.

Hypothesis Testing

The criteria used for this significance test are as follows: 1) If the probability value exceeds 0.05, there is no effect between the independent and dependent constructs; thus, H0 is accepted and Ha is rejected. 2) If the probability value is less than 0.05, there is an effect between the independent and dependent constructs; thus, H0 is rejected and Ha is accepted. Testing was also conducted to examine direct and indirect effects.

Table 10. Hypothesis Testing

Relationships Between Variables	Original Sample (O)	Sample Mean (M)	STDEV	T-Statistics	P-Values	Conclusion
Direct Influence						
Maritime English Competence (X1) -> Human Capital Capability (Z)	0,168	0,171	0,046	3,614 > 1,968	0,000* < 0,05	Has a positive and significant effect
Digital Literacy (X2) -> Human Capital Capability (Z)	0,324	0,318	0,062	5,239 > 1,968	0,000* < 0,05	Has a positive and significant effect
Grit (X3) -> Human Capital Capability (Z)	0,440	0,440	0,047	9,348 > 1,968	0,000* < 0,05	Has a positive and significant effect
Technostress (X4) -> Human Capital Capability (Z)	0,005	0,001	0,048	0,107 < 1,968	0,915 > 0,05	Has a negative and insignificant effect
Maritime English Competence (X1) -> Crew Performance (Y)	-0,036	-0,036	0,049	0,732 < 1,968	0,464 > 0,05	Has a negative and insignificant effect
Digital Literacy (X2) -> Crew Performance (Y)	0,099	0,103	0,067	1,481 < 1,968	0,139 > 0,05	Has a negative and insignificant effect
Grit (X3) -> Crew Performance (Y)	0,254	0,259	0,073	3,473 > 1,968	0,000* < 0,05	Has a positive and significant effect
Technostress (X4) -> Crew Performance (Y)	-0,017	-0,006	0,027	0,644 < 1,968	0,519 > 0,05	Has a negative and insignificant effect
Human Capital Capability (Z) -> Crew Performance (Y)	0,579	0,571	0,090	6,413 > 1,968	0,000* < 0,05	Has a positive and significant effect
Indirect Influence						
Maritime English Competence (X1) -> Crew Performance (Y)	0,097	0,097	0,029	3,390 > 1,968	0,000* < 0,05	Has a positive and significant effect
Digital Literacy (X2) -> Crew Performance (Y)	0,187	0,181	0,046	4,059 > 1,968	0,000* < 0,05	Has a positive and significant effect
Grit (X3) -> Crew Performance (Y)	0,255	0,251	0,047	5,390 > 1,968	0,000* < 0,05	Has a positive and significant effect
Technostress (X4) -> Crew Performance (Y)	0,003	0,000	0,027	0,107 < 1,968	0,914 > 0,05	Has a negative and insignificant effect

Discussion

Following the validity, reliability, and hypothesis testing conducted using the SmartPLS analysis tool, the discussion of the results regarding the research carried out at this manufacturing company is presented below:

The Influence of English Language Competence on Human Capital Capability

The English language competence construct yielded a coefficient of 0.168, a t-statistic of 3.614 (exceeding the 1.968 threshold), and a p-value of 0.000. Since the t-statistic exceeds the

t-table value of 1.968 and the p-value is less than 0.05, English language competence has a positive and significant effect on human capital capability.

These results indicate that the higher a seafarer's English language competence, the stronger their human capital capability. English serves as the working language of international shipping; consequently, the ability to comprehend commands, safety procedures, and equipment manuals as well as to communicate with multinational crews and port authorities constitutes part of the knowledge and skills that shape human capital.

The coefficient of 0.168 is the lowest among the three significant antecedents, suggesting that English language competence acts as a foundation rather than a dominant determinant. For shipping companies, maritime English training focused on shipboard communication needs to be integrated with the strengthening of other capability aspects.

The results of this study align with Ely Sulistiyowati et al., (2026), who views language skills as a form of human capital that increases workforce productivity, as well as Purba & Siska, (2025), which demonstrates that English serves as the basis for communication and ship operations among multilingual crews.

The Influence of Digital Literacy on Human Capital Capability

The digital literacy construct has a coefficient of 0.324, a t-statistic of 5.239 (exceeding the 1.968 threshold), and a p-value of 0.000. Since the t-statistic exceeds the t-table value of 1.968 and the p-value is less than 0.05, digital literacy has a positive and significant effect on human capital capability.

These results indicate that digitally literate seafarers possess stronger human capital capability. Digital literacy encompasses the ability to search for, understand, and utilize digital information skills that are relevant given the increasing reliance of shipboard operations on digital navigation, communication, and reporting systems (Putra et al., 2026). This capability enables seafarers to rapidly acquire new knowledge and skills, thereby enriching their capabilities.

A coefficient of 0.324 places digital literacy as the second-highest antecedent. Shipping companies need to incorporate training on digital systems on board as part of crew development, not simply as a tool introduction.

These research findings align with Prastianto et al., (2026) which demonstrates that digital skills are part of the 21st-century skills required by workers, and views digital literacy as a fundamental skill for surviving and thriving in the digital era.

The Influence of Grit on Human Capital Capability

The grit construct has a coefficient of 0.440, a t-statistic of 9.348 > 1.968, and a p-value of 0.000. Because the t-statistic is greater than the t table of 1.968 and the p-value is smaller than 0.05, grit has a positive and significant effect on human capital capability.

These results indicate that grit is the strongest antecedent of human capital capability in this study (coefficient of 0.440). Grit encompasses perseverance and consistency of interest regarding long-term goals. Persistent seafarers continue to practice, learn from their sailing experiences, and endure the demands of long-term work at sea, allowing their knowledge and skills to accumulate into capabilities.

These findings demonstrate that crew capabilities are shaped not only by formal training but also by the trait of perseverance. Shipping companies can take resilience and perseverance into account during the selection and development of seafarers for instance, through mentoring by senior seafarers.

The results of this study align with Yang et al., (2024), demonstrating that grit predicts individual success and resilience in demanding fields including among military cadets and highlighting the role of the perseverance-of-effort dimension.

The Influence of Technostress on Human Capital Capability

The technostress construct yielded a coefficient of 0.005, a t-statistic of 0.107 (below the t-table value of 1.968), and a p-value of 0.915. Since the t-statistic is lower than the t-table value of 1.968 and the p-value exceeds 0.05, technostress has no significant effect on human capital capability.

These results indicate that technostress does not diminish the human capital capability of seafarers. The coefficient of 0.005 is close to zero, suggesting no tendency for technostress to alter capabilities. Capabilities represent a relatively stable accumulation of knowledge, skills, and abilities, whereas technostress is more of a situational pressure. Furthermore, a survey of 411 ship officers revealed moderate levels of technostress regarding workload and technological uncertainty, and low levels regarding technological complexity; thus, the pressure may not have been sufficient to impact capabilities.

These findings do not imply that technostress can be ignored. Shipping companies must continue to monitor the technological burden experienced by crew members particularly as digitalization increases through measures such as adequate training and technical support.

The results of this study align with Hessari et al., (2024), which reports that seafarers' technostress levels fall only within the low-to-moderate range, indicating that low-intensity technological stressors can mitigate the impact of other stressors, such that technostress does not necessarily affect individual outcomes.

The Influence of English Language Competence on Ship Crew Performance

The English language competence construct yielded a coefficient of -0.036, a t-statistic of 0.732 (below the 1.968 threshold), and a p-value of 0.464. Since the t-statistic is lower than the critical t-value of 1.968 and the p-value exceeds 0.05, English language competence has no significant effect on crew performance.

These results indicate that English language competence does not directly influence crew performance. While English proficiency is necessary, a seafarer's performance also relies on technical knowledge, skills, and experience. English appears to serve as a means to acquire and utilize these capabilities rather than acting as a direct determinant of performance; this is reflected in the finding that the influence only manifests through human capital capability.

For shipping companies, maritime English training should not be conducted in isolation but rather linked to the enhancement of operational skills so that the benefits are reflected in performance.

The results of this study align with the findings of Indra et al., (2024), which emphasizes the direct role of English in ship operations, necessitating further testing in other contexts.

The Influence of Digital Literacy on Crew Performance

The digital literacy construct has a coefficient of 0.099, a t-statistic of 1.481 (which is less than the critical value of 1.968), and a p-value of 0.139. Since the t-statistic is lower than the t-table value of 1.968 and the p-value exceeds 0.05, digital literacy has no significant effect on crew performance.

These results indicate that digital literacy does not directly influence crew performance. The ability to use technology does not automatically enhance performance unless it is translated into concrete work-related knowledge and skills; this is evidenced by the fact that digital literacy exerts a significant influence only through human capital capability.

Shipping companies need to link digital literacy training to actual shipboard tasks—such as the use of navigation and communication systems—to ensure that digital capabilities translate into performance.

These research findings are consistent with Noerkajati et al., (2026), which positions digital skills as a crucial component of workplace skills, necessitating a re-examination of their direct impact in the context of seafarers.

The Effect of Grit on Ship Crew Performance

The grit construct yielded a coefficient of 0.254, a t-statistic of 3.473 (exceeding the 1.968 threshold), and a p-value of 0.000. Since the t-statistic exceeds the critical value of 1.968 and the p-value is below 0.05, grit has a positive and significant effect on crew performance.

These results indicate that grit has a direct positive impact on crew performance (coefficient of 0.254). Seafaring demands resilience in the face of isolation, long working hours, and fluctuating sea conditions. Seafarers with grit persist in completing tasks and maintaining consistent performance under such conditions, thereby achieving better results.

Grit emerged as the sole antecedent with a direct influence on performance. Fostering mental resilience mfor instance, through mentoring and seafarer welfare programs warrants inclusion in crew development strategies.

These research findings align with Baum-Talmor & Kitada, (2022), which shows that grit is positively associated with performance, albeit with a moderate magnitude.

The Effect of Technostress on Ship Crew Performance

The technostress construct yielded a coefficient of -0.017, a t-statistic of 0.644 (below the 1.968 threshold), and a p-value of 0.519. Since the t-statistic is lower than the critical t-value of 1.968 and the p-value exceeds 0.05, technostress has no significant effect on crew performance.

These results indicate that technostress does not directly affect crew performance (coefficient of -0.017). The moderate-to-low levels of technostress experienced by the seafarers may not have been sufficient to disrupt the execution of their duties. The impact of technological stressors also depends on their nature, as some stressors can act as motivating challenges rather than hindrances.

The study's findings align with the view that the impact of technological stressors depends on their intensity; the observed moderate-to-low levels of seafarer technostress resulted in no apparent effect on performance (Ma & Liao, 2025).

The Influence of Human Capital Capability on Ship Crew Performance

The human capital capability construct has a coefficient of 0.579, a t-statistic of 6.413 (exceeding the 1.968 threshold), and a p-value of 0.000. Since the t-statistic exceeds the critical t-value of 1.968 and the p-value is less than 0.05, human capital capability has a positive and significant effect on crew performance.

These results indicate that human capital capability is the strongest determinant of crew performance (coefficient of 0.579). Seafarers possessing adequate knowledge, skills, and abilities are better equipped to perform watchkeeping duties, operate equipment, and handle emergency situations. Human capital is a valuable resource for performance.

These findings confirm that investing in crew capabilities whether through training, assignments, or career development is the most direct pathway to enhancing performance. The highest coefficient in the model also suggests that human capital capability warrants being the primary focus of crew management.

The results of this study are consistent with Isah Leontes & Hoole, (2024), which found that human capital is positively related to performance, and demonstrated that human capital is linked to performance.

The Influence of English Language Competence on Crew Performance Mediated by Human Capital Capability

The English language competence construct yielded a coefficient of 0.097, a t-statistic of 3.390 (exceeding the 1.968 threshold), and a p-value of 0.000. Since the t-statistic exceeds the critical t-value of 1.968 and the p-value is less than 0.05, English language competence has a significant influence on crew performance, mediated by human capital capability.

These results indicate that human capital capability mediates the influence of English language competence on crew performance. The combination of a non-significant direct effect and a significant indirect effect (0.097) demonstrates full mediation (indirect-only). English proficiency enhances performance by strengthening seafarers' capabilities, rather than through a direct effect.

Maritime English training will impact performance if accompanied by the strengthening of work capabilities for instance, through operational communication practice and onboard procedural training.

These research findings are consistent with Rozi & Rizky, (2024), which views individual characteristics as the basis for the formation of human capital resources that subsequently determine performance, and explains full mediation as a condition where only the indirect effect is significant.

The Influence of Digital Literacy on Ship Crew Performance Mediated by Human Capital Capability

The digital literacy construct yielded a coefficient of 0.187, a t-statistic of 4.059 (exceeding the critical value of 1.968), and a p-value of 0.000. Since the t-statistic exceeds the t-table value of 1.968 and the p-value is less than 0.05, digital literacy has a significant effect on crew performance, mediated by human capital capability.

These results indicate that human capital capability mediates the impact of digital literacy on crew performance. The combination of a non-significant direct effect and a significant indirect effect (0.187) demonstrates full mediation. Digital literacy enhances performance by strengthening seafarers' capabilities in utilizing digital systems and absorbing new knowledge.

Shipping companies need to ensure that digital literacy training results in capability improvements applicable to the job, rather than serving merely as an introduction to technology.

These research findings are consistent with Yu et al., (2025), which views individual capabilities as a pathway to performance, and addresses full mediation while positioning digital skills as a component of work skills.

The Influence of Grit on Ship Crew Performance Mediated by Human Capital Capability

The grit construct yielded a coefficient of 0.255, a t-statistic of 5.390 (exceeding the critical value of 1.968), and a p-value of 0.000. Since the t-statistic exceeds the t-table value of 1.968 and the p-value is less than 0.05, grit has a significant effect on crew performance, mediated by human capital capability.

These results indicate that human capital capability mediates the impact of grit on crew performance. Both the direct effect (0.254) and the indirect effect (0.255) are significant, signifying partial mediation, with approximately 50.1% of the total effect of grit occurring through human capital capability. Grit enhances performance both directly through work perseverance and indirectly through the development of capabilities.

These two pathways confirm that grit is a key factor. Shipping companies need to support seafarers' perseverance by providing learning opportunities and assignments that develop their capabilities, thereby transforming that perseverance into performance.

These research findings are consistent with Belabyad et al., (2026), which views individual characteristics as the basis of capabilities that determine performance.

The Influence of Technostress on Ship Crew Performance Mediated by Human Capital Capability

The technostress construct yielded a coefficient of 0.003, a t-statistic of 0.107 (below the 1.968 threshold), and a p-value of 0.914. Since the t-statistic is lower than the critical t-value of 1.968 and the p-value exceeds 0.05, technostress has no significant effect on crew performance when mediated by human capital capability.

These results indicate that human capital capability does not mediate the impact of technostress on crew performance. The indirect effect of 0.003 is statistically insignificant because technostress has no effect on human capital capability (0.005) and no direct effect on performance (-0.017). Consequently, technostress does not exert a significant influence on performance within this model.

Shipping companies should direct resources toward antecedents with proven influence namely grit, digital literacy, and English language proficiency while continuing to monitor technostress, given that the currently low-to-moderate levels observed among seafarers (Bayrak & Muslu, 2025) could rise alongside increasing digitalization.

The findings of this study align with Bayrak & Muslu, (2025), which found moderate to low levels of technostress among seafarers and demonstrated that the impact of technological stressors depends on their nature and intensity, such that technostress does not always affect performance either directly or through intermediaries.

CONCLUSION

Conclusion

Based on the problem formulation, results, and discussion above, the conclusions of this study are: 1) English language competence has a positive and significant effect on human capital capability; 2) Digital literacy has a positive and significant effect on human capital capability; 3) Grit has a positive and significant effect on human capital capability; 4) Technostress does not have a significant effect on human capital capability; 5) English language competence does not have a significant effect on crew performance; 6) Digital literacy does not have a significant effect on crew performance; 7) Grit has a positive and significant effect on crew performance; 8) Technostress does not have a significant effect on crew performance; 9) Human capital capability has a positive and significant effect on crew performance; 10) Human capital capability fully mediates the effect of English language competence on crew performance; 11) Human capital capability fully mediates the effect of digital literacy on crew performance; 12) Human capital capability partially mediates the effect of grit on crew performance; 13) Human capital capability does not mediate the effect of technostress on crew performance.

In general, crew performance is primarily determined by human capital capability and grit, whereas English language competence and digital literacy exert their influence through the development of human capital capability.

Research Limitations

This study has the following limitations: 1) Data were collected via questionnaires at a single point in time (cross-sectional), meaning causal relationships between variables cannot be definitively established and the data are perceptual in nature; 2) Respondents were limited to 316 seafarers from Indonesian shipping companies, so caution should be exercised when generalizing the findings to seafarers in other countries or on specific types of vessels.

Suggestions

Based on the conclusions above, the suggestions for shipping companies are: 1) Prioritize the strengthening of human capital capability in crew development through technical training, progressive assignments, and career development; 2) Foster seafarer grit through senior seafarer mentoring, welfare programs, and mental health support; 3) Link maritime English training and digital literacy to shipboard operational tasks to impact capabilities and performance.

Regulators and seafarer education institutions are advised to incorporate the strengthening of perseverance and digital literacy into curricula and continuous training.

Future researchers are advised to: 1) Use longitudinal designs or multi-source data (e.g., supervisor assessments) to test causality and reduce perceptual bias; 2) Refine the measurement of technostress; 3) Include moderating variables such as rank, vessel type, and tenure; 4) Expand the sample to include female seafarers and various types of shipping companies.

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