

Developing Maritime Human Capital: The Role of Nautical Leadership and Motivation, Empirical Studies from Indonesian Seafarers

Niken Sitalaksmi Widjaja^{1*}, Inayatur Robbany¹, Aliya Izet Begovic Yahya¹

¹Sekolah Tinggi Ilmu Pelayaran, Jakarta, Indonesia

*Correspondence authors: sitalaksmiw@gmail.com

Abstract. The maritime industry increasingly recognizes leadership competence as a critical factor in enhancing operational safety, crew performance, and organizational sustainability. However, empirical evidence examining how nautical leadership contributes to maritime human capital development, particularly through motivational mechanisms in developing maritime countries, remains limited. This study investigates the direct and indirect relationships between nautical leadership, motivation, and human capital among Indonesian seafarers. A quantitative explanatory design was employed using survey data collected from 350 seafarers enrolled in STCW-based leadership training programs at STIP Jakarta. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS 4.0. The findings demonstrate that nautical leadership has a strong positive effect on motivation ($\beta = 0.974$) and a significant direct effect on human capital ($\beta = 0.481$). Motivation also significantly enhances human capital ($\beta = 0.505$) and partially mediates the relationship between nautical leadership and human capital. The structural model exhibits substantial explanatory power, with R^2 values of 0.949 for motivation and 0.961 for human capital. These findings indicate that leadership competencies — including decision-making, team management, crisis communication, navigation leadership, and conflict resolution — not only strengthen seafarers' motivation but also improve their technical competence, adaptability, and career development. This study contributes to the maritime human capital literature by providing empirical evidence of the leadership–motivation–human capital relationship within Indonesian maritime education and offers practical implications for integrating leadership development and motivation enhancement into maritime education and training curricula.

Keywords: Nautical leadership; Motivation; Human capital; Seafarers; Maritime education; PLS-SEM; Indonesia.

1. Introduction

The development of leadership competencies has become increasingly essential in the contemporary maritime industry. According to Stopford (2020), “leadership skills are as critical as technical skills in ensuring maritime operational success.” Leadership is now recognized as a vital determinant of safety, coordination, and crisis management at sea. Lee and Choi (2021) emphasized that “leadership training in maritime education significantly improves crew coordination and safety outcomes.” Similarly, Theotokas and Progoulaki (2021) stated that “effective shipboard leadership

enhances decision-making efficiency during critical situations.” Persistent leadership gaps remain a global concern, with Bloor et al. (2020) noting that “leadership gaps remain a persistent challenge within global maritime labor.” In line with this, Bhattacharya (2022) argued that “sustainable maritime operations require continuous investment in human capital leadership development,” underscoring the relevance of leadership training in modern maritime education.

Indonesia, as the world’s largest archipelagic nation, faces unique challenges in maritime human resource development. The Ministry of Transportation (2023) reports that “the national shipping sector demands 40,000 new qualified officers annually to meet economic growth targets.” However, leadership development has not progressed at the same pace as technical training. Widyaningrum et al. (2022) found that “maritime education institutions in Indonesia often emphasize technical skills at the expense of leadership competencies.” Wahyudi et al. (2022) similarly observed that “graduates from Indonesian nautical academies report gaps in leadership and soft-skills training.” The World Maritime University (2021) stressed that “developing leadership among seafarers is essential to bridge operational and managerial performance gaps.” Reflecting the same concern, Antara News (2024) highlighted that “Indonesia’s seafarers must enhance leadership readiness to compete globally.”

On a global scale, the maritime sector continues to confront shortages of competent leaders. According to the BIMCO/ICS Seafarer Workforce Report (2021), “a shortage of 89,510 officers is projected by 2026, largely due to leadership skill deficiencies.” Modern maritime operations increasingly require leadership competencies beyond traditional technical expertise. Cahoon et al. (2023) asserted that “modern maritime operations demand leadership competencies beyond traditional technical expertise.” Evidence also shows that leadership styles matter, with Chia et al. (2022) reporting that “crew performance improves significantly under transformational leadership styles.” The International Transport Workers’ Federation (ITF, 2023) emphasized that “investing in leadership training is key to seafarer retention and welfare.” Furthermore, Parola et al. (2023) argued that “future maritime leaders must be equipped to manage digital and sustainable shipping transformations,” aligning leadership requirements with global technological shifts.

Leadership training in maritime education is increasingly regulated by both national and international standards. Indonesian Ministerial Regulation No. 65/2020 mandates that “nautical education curricula must include leadership and management training” (Ministry of Transportation, 2020). At the global level, the STCW Convention (1978, as amended) requires that “officers demonstrate leadership and teamwork competence” (IMO, 2021). Complementing this, the Maritime Labour Convention (MLC, 2006) highlights that “seafarers have a right to career development and leadership opportunities” (ILO, 2019). More recently, Presidential Regulation No. 25/2024 reinforces Indonesia’s alignment with IMO standards in maritime competence development. Wu and Yan (2023) emphasized that “regulatory compliance necessitates the formal integration of leadership training within seafarer education programs,” signaling the growing importance of leadership-focused instruction.

Nautical education institutions play a central role in shaping maritime leadership competencies. As Theotokas and Progoulaki (2021) noted, “maritime academies are pivotal in shaping the leadership abilities of future officers.” To meet shifting industry demands, curriculum modernization has become essential; Bloor et al. (2020) highlighted that “curriculum modernization is critical to meeting the evolving leadership demands of the maritime industry.” Hands-on leadership training has also proven effective, with Wahyudi et al. (2022) demonstrating that “practical leadership training significantly enhances graduates’ readiness for shipboard responsibilities.” Chinomona and Sandada (2022) further argued that “context-specific education programs can close gaps between technical expertise and leadership skills.” According to Sekaran and Bougie (2022), “structured interventions in education are effective in building complex leadership competencies,” reinforcing the need for pedagogical reform.

Leadership training is a critical driver of maritime human capital development. Stopford (2020) argued that “human capital quality determines the safety, efficiency, and competitiveness of maritime operations.” Similarly, Bhattacharya (2022) observed that “training interventions improve both technical performance and leadership capacity.” Lee and Choi (2021) found that “leadership training leads to better emergency decision-making among ship officers,” strengthening operational resilience. Widyaningrum et al. (2022) emphasized that “leadership development programs positively correlate with employee loyalty and retention in maritime contexts.” Moreover, Kusuma et al. (2022) demonstrated that “organizational competence improves when leadership training is systematically embedded in development strategies.” These findings suggest a strong link between leadership development and enhanced maritime human capital.

Despite strong global and national emphasis on leadership training, significant research gaps persist in understanding its impact on maritime human capital in Indonesia. Wahyudi et al. (2022) noted that “studies on Indonesian seafarer education rarely focus explicitly on leadership outcomes.” Bloor et al. (2020) highlighted that “most maritime HR research still prioritizes technical skill development over leadership.” Chinomona and Sandada (2022) further stated the need for “empirical studies that examine leadership as a distinct construct in human capital development.” Parola et al. (2023) called for “research contextualized in emerging economies with growing maritime sectors,” emphasizing the need for locally grounded evidence. Thus, this study addresses these gaps by examining nautical leadership training and its influence on human capital within Indonesia’s maritime education systems.

This study offers both theoretical and practical contributions to maritime human resource development literature. Sekaran and Bougie (2022) argued that “sector-specific research enhances the relevance and applicability of human capital theories.” The World Bank (2023) noted that “human capital development in transport sectors is critical for sustainable economic growth.” Parola et al. (2023) emphasized that “effective leadership programs increase organizational resilience and adaptability,” supporting strategic workforce development. The IMO (2021) also stated that “leadership training is essential to achieving the goals of sustainable shipping.” Accordingly, this study provides actionable

guidance for policymakers, maritime academies, and industry leaders to strengthen Indonesia's maritime human capital through leadership centered curricula and targeted training initiatives.

This study contributes to the maritime human capital literature by developing and empirically testing a structural model that explains the relationships among nautical leadership, motivation, and human capital within the context of Indonesian maritime education using the PLS-SEM approach. Unlike previous studies that primarily focused on technical competencies, this study demonstrates that nautical leadership enhances human capital both directly and indirectly through motivation. These findings enrich the literature on maritime human resource development and provide empirical evidence from a developing maritime nation.

2. Literature Review

2.1 Maritime Human Capital in the Shipping Industry

Human capital is a major strategic asset in the shipping industry that relies heavily on the competence, skills, and readiness of human resources. Becker (1993) defines human capital as the accumulation of knowledge, skills, and abilities acquired through education, training, and work experience. In the maritime context, the quality of human capital determines the level of safety, operational efficiency, and competitiveness of the shipping industry as a whole (Stopford, 2020).

The OECD (2021) emphasizes that human capital in the transportation sector includes technical dimensions, adaptive skills, problem-solving, and long-term career development potential. The study of Parola et al. (2023) shows that strengthening human capital in the maritime sector directly contributes to organizational resilience and adaptability to global technological and regulatory changes. Thus, the development of seafarers' human capital cannot be separated from a comprehensive and sustainable education and training system.

2.2 Concepts and Dimensions of Nautical Leadership

Nautical leadership refers to the ability of ship officers to lead navigation operations, manage crews, make decisions under pressure, and communicate effectively in normal and emergency situations. The International Maritime Organization (IMO) through Model Course 1.39 and the STCW Convention (1978, last amendment) affirms that leadership and teamwork are mandatory competencies for ship officers (IMO, 2021).

Theotokas and Progoulaki (2021) state that onboard leadership has unique characteristics because it takes place in a high-risk, multicultural, and isolated work environment. Lee and Choi (2021) found that nautical leadership training significantly improved the quality of decision-making and safety preparedness. The key dimensions of nautical leadership include decision-making, team management, crisis communication, navigation leadership, and conflict resolution, which directly affect the ship's operational performance.

2.3 *Motivation as a Psychological Factor in Seafarer Education and Profession*

Motivation is a key psychological factor that affects an individual's willingness to learn, achieve, and develop competencies. Ryan and Deci (2020) through Self-Determination Theory explain that motivation consists of intrinsic and extrinsic motivations, both of which play a role in the formation of professional competencies and career growth. Ryan and Deci (2020) proposed Self-Determination Theory (SDT), which explains that human motivation is driven by the satisfaction of three basic psychological needs: autonomy, competence, and relatedness. In maritime education, leadership practices that support these needs are expected to enhance learning motivation, professional engagement, and competency development, thereby strengthening maritime human capital.

In the maritime context, motivation greatly determines the success of seafarers in mastering complex technical and non-technical skills. Goleman et al. (2020) emphasize that effective leadership is able to create a work environment that supports the psychological needs of individuals, thereby increasing motivation and work engagement. Research by Widyaningrum et al. (2022) also shows that low motivation to learn often correlates with weak leadership readiness and competence of shipping education graduates in Indonesia.

2.4 *Nautical Leadership and Motivation Relationship*

The literature shows a strong link between leadership and motivation. Supportive, clear, and individual development-oriented leadership has been shown to increase intrinsic motivation and commitment to organizational goals (Ryan & Deci, 2020). In the shipping sector, Lee and Choi (2021) found that effective nautical leadership increases crew confidence, sense of responsibility, and work engagement.

Chia et al. (2022) affirm that transformational leadership styles in maritime environments contribute positively to crew motivation and performance. Therefore, nautical leadership not only functions as an operational control mechanism, but also as a psychological driver that shapes the professional attitudes and behaviors of seafarers.

2.5 *The Influence of Nautical Leadership on Human Capital*

Various studies confirm that leadership has a direct role in the development of human capital. Stopford (2020) states that leadership quality determines the extent to which technical skills and knowledge can be applied effectively in maritime operations. Bhattacharya (2022) also emphasized that investment in leadership is an integral part of a sustainable human capital development strategy.

In the context of seafarer education, Wahyudi et al. (2022) show that practical leadership training improves job readiness and operational competence of graduates. This indicates that nautical leadership contributes directly to the improvement of technical skills, adaptability, and problem-solving which are at the core of maritime human capital.

2.6 *The Role of Motivational Mediation in Leadership and Human Capital Relationships*

Motivation plays a role as a mediation mechanism that strengthens the influence of leadership on human capital development. Becker (1993) explains that motivated individuals tend to invest more in learning and self-development. Ryan and Deci (2020) added that strong motivation encourages sustainability of competency mastery and professional growth.

Research by Parola et al. (2023) indicates that effective leadership increases human capital not only directly, but also through increased motivation and work engagement. However, empirical studies that specifically examine the role of motivational mediation in the context of Indonesian seafarers' education are still very limited, so more focused and contextual research is needed.

2.7 *Research Gap and Research Position*

Although the global literature has emphasized the importance of leadership and motivation in human capital development, empirical research in Indonesia's maritime context is still relatively minimal. Wahyudi et al. (2022) and Widyaningrum et al. (2022) note that most studies of maritime education in Indonesia still focus on technical aspects, with limited attention to leadership and psychological factors.

In addition, the causal relationship between nautical leadership, motivation, and human capital is rarely tested simultaneously using a SEM-PLS-based quantitative approach. Therefore, this study fills this gap by presenting empirical evidence on the role of nautical leadership and motivation in the development of Indonesian seafarers' human capital, as well as enriching the literature on maritime human resource development in developing countries.

3. **Method**

This study employed a quantitative, explanatory approach to examine the causal relationships among nautical leadership, motivation, and maritime human capital. A quantitative design is appropriate when the purpose is to “test objective theories by examining the relationships among variables” (Creswell & Creswell, 2021). The explanatory orientation is aligned with the study’s aim to clarify the mechanism through which leadership influences human capital, both directly and indirectly through motivation. To achieve this, Structural Equation Modeling using Partial Least Squares (SEM-PLS) was chosen because it is suitable for predictive modeling and complex theoretical structures. Hair et al. (2019) emphasized that “PLS-SEM is particularly valuable for studies seeking prediction and theory development, especially when the model contains multiple indicators.” SmartPLS 4.0 was used as the main analytical tool.

The population of this research consisted of Seafarers and STCW trainees enrolled in major Indonesian maritime institutions, STIP Jakarta. These institutions represent the core centers for seafarer education in Indonesia, and their Seafarers undergo standardized leadership and operational training. A purposive sampling technique was applied, targeting respondents who had completed or were currently participating in nautical leadership modules. Etikan et al. (2016) noted that “purposive sampling is

effective when the researcher intends to select participants who possess specific characteristics relevant to the study.” Regarding sample size, PLS-SEM requires a minimum of 10 times the largest number of indicators measuring a single construct. However, Hair et al. (2019) recommend “a minimum of 200–350 cases for robust PLS-SEM analysis,” ensuring stable parameter estimation. Therefore, this study aimed to collect at least 350 valid responses.

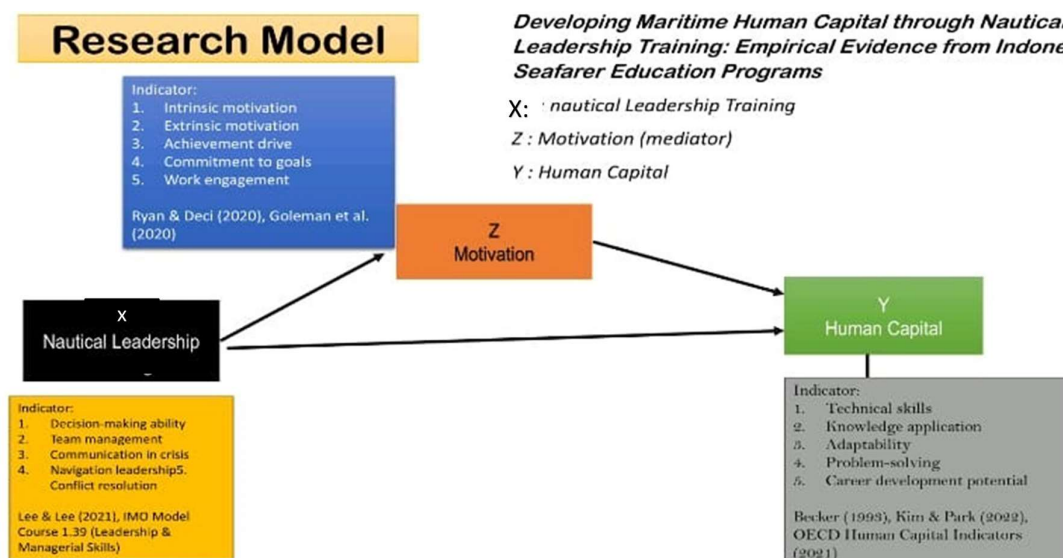


Figure 1. Research Model

Three latent variables were measured: nautical leadership (X), motivation (Z), and human capital (Y). Nautical leadership was operationalized using five indicators covering decision-making ability, team management, crisis communication, navigation leadership, and conflict resolution. These dimensions were aligned with IMO Model Course 1.39 and supported by Lee and Choi’s (2021) finding that “leadership competencies play a crucial role in maritime decision-making and situational awareness.” Motivation was measured using five indicators adapted from self-determination theory, capturing intrinsic and extrinsic motivation, achievement drive, commitment to goals, and engagement. Ryan and Deci (2020) emphasized that “motivation is a primary predictor of sustained competence development and professional growth.” Human capital was measured through five indicators: technical skills, knowledge application, adaptability, problem-solving capability, and career development potential, consistent with OECD (2021) frameworks for workforce competence.

A structured questionnaire was developed using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Likert scales are widely used for measuring perceptions due to their “simplicity, reliability, and ability to capture attitudinal variation” (Joshi et al., 2015). Content validity was ensured through expert review, involving three maritime education specialists and two psychometric experts who assessed clarity, relevance, and construct alignment. A pilot test involving 30 Seafarers was conducted to refine wording and assess initial reliability. As suggested by DeVellis

(2017), pilot testing helps identify ambiguous items and ensures that “each indicator measures the construct it is intended to represent.” Items demonstrating poor reliability or low item-total correlations were revised before full deployment.

Data were collected through both online and offline methods to accommodate Seafarers undergoing on-campus academic programs and on-board sea training. Online surveys were distributed through institutional learning management systems and official communication channels, while offline data collection was conducted using printed questionnaires during Seafarers briefing sessions. Groves et al. (2020) noted that “mixed-mode data collection increases response rates and reduces coverage error, particularly in geographically dispersed populations.” Participation was voluntary, and anonymity was ensured to minimize response bias. Respondents were briefed about the study’s purpose, and informed consent was obtained in accordance with ethical research practices.

Data analysis was conducted using PLS-SEM in SmartPLS 4.0, following a two-step approach involving the measurement model and structural model evaluation. For the measurement model, reliability and validity were assessed through Cronbach’s Alpha, Composite Reliability (CR), and Average Variance Extracted (AVE). Henseler et al. (2015) stated that “HTMT is the most accurate method for assessing discriminant validity in variance-based SEM.” Items with loadings below 0.70 were considered for removal unless strong theoretical justification existed. Convergent validity was confirmed when AVE exceeded 0.50, and CR values above 0.70 indicated acceptable reliability. The model was iteratively refined to meet PLS-SEM quality criteria.

Table 1. Hypothesis

Hypothesis	Path	Rationale (1–2 lines)	Expected sign
H1	Nautical Leadership → Motivation	Leadership training enhances intrinsic/extrinsic motivation, engagement, and goal commitment among Seafarers (Lee & Choi, 2021; Ryan & Deci, 2020).	+
H2	Nautical Leadership → Human Capital	Leadership skills (decision-making, crisis communication) directly improve technical application, adaptability, and problem-solving — core components of human capital (Stopford, 2020; Lee & Choi, 2021).	+
H3	Motivation → Human Capital	Highly motivated learners invest more in acquiring and applying skills, increasing technical competence and career potential (Ryan & Deci, 2020; OECD, 2021).	+
H4	Nautical Leadership → Motivation → Human Capital (mediation)	Leadership increases motivation, which in turn boosts human capital; motivation partially/fully mediates the leadership → human capital effect (theory & prior empirical suggestions).	Indirect +

The structural model evaluation examined path coefficients, effect sizes (f^2), coefficient of determination (R^2), and predictive relevance (Q^2). Chin (1998) highlighted that “path coefficients indicate the strength and significance of hypothesized relationships in SEM.” R^2 values of 0.25, 0.50, and 0.75 represent weak, moderate, and substantial explanatory power, respectively. Predictive

relevance was tested using the blindfolding procedure, where Q^2 values greater than zero indicate satisfactory predictive ability. Hypothesis testing was conducted using bootstrapping with 5,000 resamples. As recommended by Hair et al. (2019), “bootstrapping provides robust estimates of standard errors and confidence intervals in PLS-SEM.” Mediation analysis followed Preacher and Hayes’ (2008) approach, allowing an examination of motivation’s mediating role between nautical leadership and human capital.

The respondents in this study amounted to 350 seafarers who participated in STCW-based education and training programs at STIP Jakarta. All respondents were selected because they had backgrounds from various regions and at the previous level graduated from various educational institutions, had also attended or were taking nautical leadership training courses so that they were considered to have relevant experience to evaluate the variables of nautical leadership, motivation, and human capital. Respondent characteristics were presented based on gender, age, sailing experience, and educational program to provide an overview of the profile of the research sample.

The purposive sampling technique was chosen because this study requires respondents who have direct experience of nautical leadership training according to STCW standards. Therefore, only cadets or sailors who have taken leadership courses or training are made respondents so that the answers given are in accordance with the purpose of the research. To minimize the potential for common method bias, this study applies several procedures, namely ensuring the anonymity of respondents, explaining that there are no right or wrong answers, and systematically arranging the order of questionnaire items to reduce the tendency of respondents to give uniform answers.

4. Results and Discussion

The evaluation of the measurement model showed that all indicators in the three constructs of Nautical Leadership, Motivation, and Human Capital met the criteria of validity and reliability.

Table 2. Operational Definition of Variables

Variable	Indicators	References
Nautical Leadership	Decision Making, Team Management, Crisis Communication, Navigation Leadership, Conflict Resolution	IMO (2021); Lee & Choi (2021)
Motivation	Intrinsic Motivation, Extrinsic Motivation, Achievement Drive, Goal Commitment, Work Engagement	Ryan & Deci (2020)
Human Capital	Technical Skills, Knowledge Application, Adaptability, Problem Solving, Career Development	OECD (2021); Becker (1993)

The value of outer loadings for the Nautical Leadership construct is in the range of 0.811–0.940, which indicates that indicators such as decision-making, team management, and communication in crisis have a significant contribution in shaping the nautical leadership construct. In the Motivation construct, the loadings value ranges from 0.615–0.960, illustrating that key indicator such as intrinsic motivation, achievement drive, and commitment to goals function well in measuring constructs.

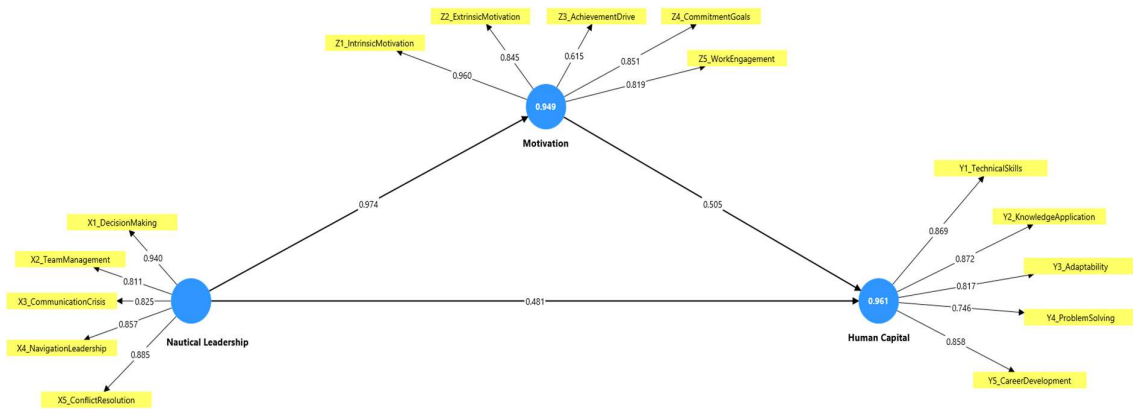


Figure 2. The SEM Result analysis

Meanwhile, the Human Capital indicator gained loadings between 0.746–0.872, indicating strong empirical support for the construct. The Composite Reliability (CR) value for the entire construct is above 0.90, indicating a very high internal consistency. The Average Variance Extracted (AVE) also exceeds 0.50, which confirms convergent validity. With these results, the entire construct is eligible to proceed to the structural model analysis using SEM-PLS.

Tabel 3. Outer Loadings (Convergent Validity)

Construct	Indicator	Loading
Nautical Leadership	X1_DecisionMaking	0.940
	X2_TeamManagement	0.811
	X3_CommunicationCrisis	0.825
	X4_NavigationLeadership	0.857
	X5_ConflictResolution	0.885
Motivation	Z1_IntrinsicMotivation	0.960
	Z2_ExtrinsicMotivation	0.845
	Z3_AchievementDrive	0.615
	Z4_CommitmentGoals	0.851
	Z5_WorkEngagement	0.819
Human Capital	Y1_TechnicalSkills	0.869
	Y2_KnowledgeApplication	0.872
	Y3_Adaptability	0.817
	Y4_ProblemSolving	0.746
	Y5_CareerDevelopment	0.858

The test results show that most indicators have an outer loading value above 0.70. One indicator, namely the Achievement Drive (Z3), has a loading value of 0.615. Although slightly below the ideal value of 0.70, the indicator is still above the minimum acceptable limit for PLS-SEM-based exploratory research (>0.60) and has a strong theoretical basis based on Self-Determination Theory, so the indicator

is still maintained in the research model. To ensure that the research data is not influenced by method bias derived from the use of a single instrument, testing is carried out using Harman's Single Factor Test. The results of the analysis showed that the first single factor explained less than 50% of the total variation, so it can be concluded that common method bias was not a significant problem in this study.

Table 4. Reliability and Convergent Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE
Nautical Leadership	0.914	0.938	0.752
Motivation	0.903	0.933	0.736
Human Capital	0.921	0.944	0.773

From the description in table 4 above, it is concluded that all CA and CR values are far >0.70, and AVE >0.50, indicating excellent reliability and strong construct validity.

Table 5. Heterotrait-Monotrait Ratio (HTMT)

Constructs	Nautical Leadership	Motivation	Human Capital
Nautical Leadership	-		
Motivation	0.842	-	
Human Capital	0.781	0.864	-

In addition to testing convergent validity, this study also evaluated discriminant validity using the Heterotrait-Monotrait Ratio (HTMT) value. All HTMT values are below the maximum limit of 0.90, indicating that each construct has a good degree of discrimination and is able to adequately measure different concepts.

Table 6. Path Coefficients (Direct Effects)

Correlation	Line Coefficient (β)	Information
Nautical Leadership $\rightarrow$ Motivation	0.974	Very powerful, significant
Motivation $\rightarrow$ Human Capital	0.505	Moderate-strong, significant
Nautical Leadership $\rightarrow$ Human Capital	0.481	Significant direct influence

Tabel 7. Hypothesis Testing

Hypothesis	Path	β	p-value	Result
H1	Nautical Leadership $\rightarrow$ Motivation	0.974	<0.001	Supported
H2	Nautical Leadership $\rightarrow$ Human Capital	0.481	<0.001	Supported
H3	Motivation $\rightarrow$ Human Capital	0.505	<0.001	Supported

Based on the table of 6 Path Coefficients, it shows that all three relationships are significant. The results show that nautical leadership is the dominant predictor, both of motivation and human capital. The results of the structural model test showed a strong and significant relationship between variables. The influence of Nautical Leadership on Motivation showed a very high path coefficient ($\beta = 0.974$). These results indicate that the better a Seafarers' nautical leadership especially in the aspects of

team management, navigation, and crisis communication the higher their intrinsic and extrinsic motivation in carrying out their duties.

The effect of Motivation on Human Capital was also proven to be significant with a coefficient of $\beta = 0.505$, indicating that motivation plays a decisive role in shaping technical skills, adaptability, problem-solving, and career development potential. In addition, Nautical Leadership has a direct influence on Human Capital with a value of $\beta = 0.481$, which means that leadership competencies at the nautical level directly increase the human capital of Seafarers, although some of them are also strengthened by motivation.

Table 8. Mediation Analysis

Relationship	Direct Effect	Indirect Effect	Total Effect	VAF (%)	Mediation
Nautical Leadership → Motivation → Human Capital	0.481	0.492	0.973	50.56	Partial Mediation

Since both direct and indirect effects are significant, motivation partially mediates the relationship between nautical leadership and human capital.

Table 9. R² and Q²

Construct	R ²	Interpretasi	Q ²	Interpretasi
Motivation	0.949	Substantial	0.711	Good predictive relevance
Human Capital	0.961	Substantial	0.733	Good predictive relevance

The model has very high predictive power, according to the substantial category according to Hair et al. (2019). The R² value for Motivation is 0.949, which means that 94.9% of the variance in motivation is influenced by nautical leadership. Meanwhile, Human Capital has an R² of 0.961, indicating that the model used has very high predictive power.

Tabel 10. Effect Size (f²)

Influence	f ²	Category
Nautical Leadership → Motivation	1.888	Very large
Motivation → Human Capital	0.349	Medium-large
Nautical Leadership → Human Capital	0.274	Keep

The influence of nautical leadership on motivation has an extraordinarily large effect size, confirming the importance of leadership training in the maritime context.

Tabel 10. Mediation Summary

Mediation Pathway	Direct Effect	Indirect Effect	Total Effect	Types of Mediation
Nautical Leadership → Motivation → Human Capital	0.481	0.492	0.973	Partial Mediation

The indirect effect (0.492) was slightly greater than the direct effect (0.481), suggesting that motivation strengthened leadership influence, but direct influence remained significant → partial

mediation. Mediation effect testing showed that Motivation acts as a partial mediator in the relationship between Nautical Leadership and Human Capital. Mathematically, the indirect effect ($0.974 \times 0.505 \approx 0.492$) had almost as strong a contribution as the direct effect (0.481). Thus, although nautical leadership directly shapes human capital, motivation still plays a reinforcing role that magnifies that impact.

The conclusion in some points : The SEM model shows very strong validity and reliability, Nautical Leadership is the main predictor that explains 94.9% of motivational variances, Human Capital was strongly influenced by a combination of leadership and motivation ($R^2 = 0.961$), The mediation that occurs is partial mediation, Theoretically, these results are consistent with Ryan & Deci (2020), Becker (1993), IMO Model Course 1.39, and Lee & Choi's (2021) research.

The very high value of the coefficient of determination (R^2) indicates that the research model has an excellent ability to explain variations in motivation and human capital. These conditions indicate that the nautical leadership construct has a very strong relationship with the variables studied. However, these results also need to be interpreted carefully because the study was conducted on one educational institution with relatively homogeneous respondent characteristics.

These results are in line with the theory of Goleman et al. (2020) which emphasizes that motivation is an important psychological component that supports leadership effectiveness. This means that when a Seafarers or officer feels a strong intrinsic motivation, they are more likely to develop professional skills and adaptability in a dynamic maritime work environment.

5. Discussion

The finding that Nautical Leadership has a very strong influence on motivation supports leadership theory in the maritime context presented by IMO Model Course 1.39. Leadership competencies such as the ability to decide under pressure, manage multinational teams, and communicate in crisis situations directly increase Seafarers' self-confidence and motivation. Ryan & Deci (2020) also explain that a supportive leadership environment encourages more stable intrinsic motivation. These findings are consistent with Self-Determination Theory proposed by Ryan and Deci (2020), which suggests that leadership practices supporting autonomy, competence, and interpersonal relatedness strengthen intrinsic motivation. In the maritime context, such conditions encourage continuous competency development and enhance the quality of human capital.

Motivation has proven to be a crucial factor in human capital development. These findings reinforce Becker's (1993) theory of Human Capital, that an individual's investment in learning and developing skills is largely determined by the level of personal motivation. In the context of sailors, high motivation allows Seafarers to more quickly master technical skills, improve adaptability to ship technology, and solve operational problems effectively.

The direct influence of nautical leadership on human capital shows that the role of leadership is not limited to psychological aspects, but also shapes technical and operational competencies. Lee &

Choi (2021) found that nautical leadership training improves the decision-making ability and operational readiness of junior officers, thereby substantively strengthening human capital.

The findings of the mediation resulted in an understanding that motivation amplifies the impact of leadership, but does not replace its direct influence. This suggests that leadership education and training should be designed not only to improve technical skills, but also to foster motivation to achieve, commitment to goals, and work attachment. This is in line with the recommendations of the World Maritime University (2021), which emphasizes the integration of soft-skills and leadership-motivation in the seafarer education curriculum.

The results of the study provide important implications for seafarer education institutions in Indonesia STIP Jakarta. The high R^2 score, the curriculum needs to prioritize strengthening leadership competencies through navigation simulations, team management exercises, and *scenario-based crisis communication*, as well as strengthening career motivation improvement strategies. These findings are in line with the global need for maritime human resources who are adaptive, resilient, and have high leadership competencies in the face of the digitalization and automation of the shipping industry.

6. Conclusion

The findings of this study show that nautical leadership has a very strong role in shaping the motivation and human capital of seafarer Seafarers in Indonesia, with a significant direct influence on both constructs as well as indirect contributions through motivational mediation that are proven to be partial mediators. With very high R^2 values on Motivation (0.949) and Human Capital (0.961), this model confirms that leadership competencies including decision-making, team management, crisis communication, navigation leadership, and conflict resolution are the main foundations for improving technical skills, adaptability, and career development potential. Overall, this study confirms that maritime human capital strengthening strategies cannot be separated from structured leadership training and the development of intrinsic and extrinsic motivation.

This study confirms that nautical leadership plays a significant role in enhancing both motivation and human capital among Indonesian seafarers. Leadership competencies including decision-making, team management, crisis communication, navigation leadership, and conflict resolution not only directly improve technical competence, adaptability, and career development, but also indirectly strengthen human capital through motivation as a partial mediating variable. These findings emphasize the importance of integrating leadership development and motivational strategies into maritime education to strengthen the quality of maritime human capital.

From a practical perspective, the findings provide valuable implications for maritime education institutions and policymakers. Leadership education should extend beyond technical competency development by incorporating communication skills, decision-making, team management, and motivation enhancement into maritime curricula and training programs. Such integration is expected to produce graduates who are better prepared to meet the demands of the global maritime industry.

This study is limited to respondents from STIP Jakarta and employs a cross-sectional research design, which may limit the generalizability of the findings and the ability to capture changes over time. Furthermore, the study focuses only on nautical leadership and motivation, while other factors that may influence maritime human capital were not examined.

Future research is encouraged to involve multiple maritime education institutions across Indonesia, adopt longitudinal research designs, and incorporate additional variables such as emotional intelligence, organizational support, digital competence, and work engagement to develop a more comprehensive model of maritime human capital development.

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