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The Impact of Command And Control Effectiveness On The Realization Of Maritime Security In ALKI II, Indonesia

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ABSTRACT

This study aims to analyze the impact of command and control effectiveness on the realization of maritime security in ALKI II, Indonesia. The method used is a quantitative approach with structural equation modeling (SEM). Data was collected through the distribution of questionnaires to 306 respondents, with 11 questions divided into two variables: command and control effectiveness and maritime security. The reliability and validity of the instruments were tested using Cronbach's alpha, composite reliability, and average variance extracted (AVE). The results of the study show that command and control effectiveness has a positive and significant impact on maritime security, with a path coefficient of 0.150 and a p-value of 0.01. The F-square value of 0.19 indicates a moderate effect. Descriptive analysis also shows that the variable of command and control effectiveness has a fairly good average value for supporting maritime security strategies. Command and control effectiveness plays a significant role in enhancing maritime security in ALKI II. Improvements in information technology, personnel training, and more effective standard operational procedures can further support this effort. These findings provide practical implications for the management of maritime security in Indonesia, particularly in enhancing a more responsive and integrated command and control system.

1. Introduction.

Maritime security is a crucial aspect for countries worldwide, encompassing various economic potentials, shipping activities, trade, ecology, geopolitics, geostrategic factors, as well as potential threats of crime and/or international conflict (Kismartini et al., 2024). Maintaining maritime security requires a comprehensive understanding from various policymakers, especially naval military forces (McCabe et al., 2018; Burns, 2013). Maritime security is also vital in ensuring the survival and development of humanity in the future (Mao, & Zhang 2024; Bai, et al., 2024).

However, maritime security often faces tensions originating not only from the sea but also from land and air. These tensions continue to evolve into new areas such as cyber threats, space, cognitive domains, and the emergence of various disruptive new technologies (Rementeria, 2022). Irresponsible actors frequently trigger these tensions (Casaril & Galletta, 2024). The UN Secretary-General (Karim, 2020; Kismartini et al., 2024) identified seven contemporary threats to maritime security: piracy and armed robbery against ships; terrorist acts involving shipping, offshore installations, and other maritime interests; illicit arms trafficking and weapons of mass destruction; illicit drug trafficking; smuggling and trafficking of persons by sea; illegal fishing (Shaw, 2024); and intentional and unauthorized damage to the marine environment.

According to Galgano (2024), these threats are caused by ineffective governance on land and the inadequacy of international legal structures governed by the UN convention on the law of the sea. Furthermore, the lack of an appropriate framework to control all maritime security threats in both interna-

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tional spaces and territorial waters adds to the complexity of the problem. Therefore, there is a need to develop a national maritime safety and security coordination center (civil-military) and mutually beneficial cooperation with other countries (Paladin et al., 2021).

Indonesia, as the largest archipelagic country in the world with 17,504 islands and 92 outermost islands directly bordering several neighboring countries (Itasari, 2020; Bimo, et al. 2022; Dari et al. 2022), requires a centralized and automated security system in areas vulnerable to threats (Miketkiewicz, 2021). According to the United Nations Convention on the Law of the Sea (UNCLOS), ratified by Indonesia through Law No.17 of 1985, Indonesia has three Indonesian Archipelagic Sea Lanes (ALKI): ALKI I, ALKI II, and ALKI III (St Fatmawati, et al. 2023; Listiyono, et al. 2019).

ALKI II, which lies at the intersection between the Indian and Pacific Oceans and the continents of Asia and Australia, separates the western and eastern parts of Indonesia (Puspitawati, 2005). This route plays an important role as a sea lane for national and international vessels, as well as an alternative route for ships traversing the increasingly congested Malacca Strait (Zulkifli, et al. 2020). However, this route is also vulnerable to various violations and threats from other countries (Kharish et al., 2022), including shifts in U.S. strategic interests in the Asia-Pacific region and maritime disputes with Malaysia (deSwielande, 2012).

Another challenge faced by ALKI II is the threat from the Lombok Strait and the waters between Indonesia and the Southern Philippines, which are vulnerable to illegal activities such as smuggling, human trafficking, and terrorism (Suseto, 2021; Kharish et al., 2022). Additionally, the maritime law enforcement and security systems often experience overlapping authorities and friction between agencies, as well as sectoral ego that hinders effective coordination (Sergi, et al. 2021).

To address these issues, policies that leverage the strength of the Indonesian Navy (TNI AL) by enhancing the effectiveness of command and control functions in supporting maritime security in ALKI II are necessary (Widjajanto et al., 2013; Wibowo et al. 2024). The Indonesian National Armed Forces (TNI) institution is highly relevant in the strategy and implementation of maritime defense policies and serves as the frontline of national defense (Sudarya, 2021; Hadiwijaya, 2022). This research focuses on the effectiveness of command and control in obtaining a comprehensive situational overview, the speed of analysis and information dissemination, effective control of ships and aircraft, and information protection to achieve maritime security and resilience in ALKI II.

This research is crucial because the stability of maritime security in ALKI II is one of the main tasks of the Indonesian Navy in supporting national defense and Indonesia's vision as the world's maritime axis (Suhirwan & Prakoso, 2019; Suhirwan, 2020). Successful control of the sea can be achieved through the effectiveness of command and control, mastery of tactics and procedures, and synergy among various stakeholders in mobilizing all maritime security resources (Hidayat et al., 2019; Hutagalung, 2017). Through this research, it is hoped that strategies and recommendations can be formulated to enhance the effectiveness of command and control in facing maritime security threats in ALKI II, thereby strengthening Indonesia's maritime defense and sovereignty.

2. Literature Review.

2.1. Maritime Security.

Maritime security is a vital element in maintaining national stability, encompassing various aspects from the economy and ecology to geopolitics. According to Sagena (2019), security can be understood as a situation free from threats, dangers, anxiety, and fear. Maritime security, as Buerger (2014) and Putra & Pramono (2017) describe, involves efforts to support national, human, and economic security. Dias et al. (2018) add that maritime security includes protecting the marine environment through effective operations and exercises.

Threats to maritime security can originate from various sources, including terrorist groups, international criminals, and other non-state actors (Sagena, 2019). Okafor-Yarwood et al. (2024) assert that these threats undermine coastal states' efforts to exploit their maritime resources. Okafor-Yarwood (2020) also emphasizes the cyclical relationship between human security and national security. Brennan & Germond (2024) state that extraordinary measures are often required to address these threats, typically involving the use of armed forces.

In Southeast Asia, governments have developed maritime capabilities and promoted security cooperation to address these challenges, although limitations remain that require long-term solutions (Guan & Koh, 2022). In Indonesia, addressing maritime security issues necessitates hard and soft efforts, including training and education for maritime communities (Prasetyo et al., 2023).

2.2. Effectiveness of Command and Control.

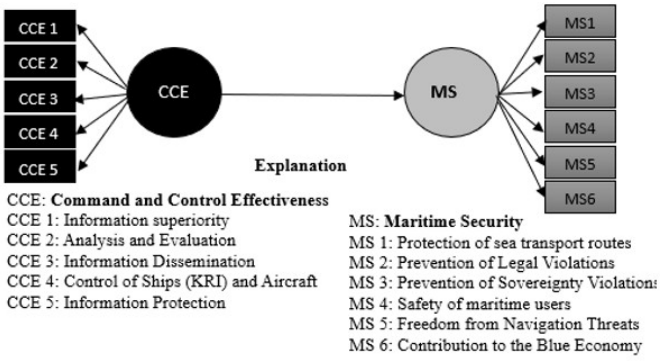
The effectiveness of command and control is crucial in maritime security operations. Suhirwan (2020) mentions that communication among law enforcement agencies is still not optimal, with infrastructure and equipment, particularly communication tools, being the main constraints. Matiuzzi Stocchero et al. (2023) emphasize that command and control systems must be adaptive to operational dynamics, including the use of UAVs and wireless sensor networks.

Nilsson (2020) highlights the importance of flexibility and adaptability in military operations, which often demand timely and decisive decisions. Effectiveness, according to Aguilera (2024), is the measure of achieving desired goals according to plan, while Ilham et al. (2022) add that effectiveness relates to coordinated and operational law enforcement. Command and control also involve institutional functions in law enforcement and security, whether at sea, on land, or in the air (Bruwer, 2020; Klauser, 2021). In the context of maritime defense, this includes pursuit, inspection, arrest, and handing over vessels to the relevant authorities for further legal processing (Durmuş 2023).

2.3. Research Framework.

This study examines the influence of command and control effectiveness on the achievement of maritime security in ALKI II, Indonesia. The research framework consists of two main variables: maritime security and command and control effectiveness, each comprising several indicators.

Figure 1: Research Conceptual Framework.



Source: Authors.

Based on the conceptual framework and the description of the variable concepts, the hypotheses of this research are:

H_0 = The Effect of Command and Control Effectiveness on Maritime Security.

H_1 = There is no effect of command and control effectiveness on maritime security.

3. Research Methods.

This research employs a quantitative method because the data used consists of numbers, and its analysis utilizes statistical techniques. One of the statistical techniques employed is structural equation modeling (SEM), which aims to analyze the relationships between factors influencing the effectiveness of command and control in supporting maritime security in ALKI II. The research begins with the development of relevant theories and research models based on existing literature. The research model is then tested through predefined hypotheses.

3.1. Population and Sample.

The population in this study consists of personnel serving on ten Republic of Indonesia Ships (KRI), each representing their respective classes, selected based on ships that have conducted operations in ALKI II between 2020 and 2023. The total population comprises 815 individuals distributed across various units in Koarmada II.

The research sample consists of 306 randomly selected respondents to obtain representative data from the larger population. This sample includes various units in Koarmada II, such as the Commander of Koarmada, Sintel, Sops, Slog, Guskamlakoarmada, Puslatkaprang Kolatkoarmada, and Puskodal, as well as personnel serving on KRI ships and aircraft. The random sampling was conducted to ensure that the research results reflect perspectives from various angles among Koarmada II personnel involved in maritime operations in ALKI II.

3.2. Data Collection Techniques.

The questionnaire was developed based on previously identified indicators and measured using a Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Data were collected using a questionnaire consisting of 11 questions: five questions for the Command and Control Effectiveness (CCE) variable and six questions for the Maritime Security (MS) variable.

4. Data Analysis.

In the research findings, descriptive analysis will outline the data collected through the questionnaire distributed to 306 respondents. This analysis will include the distribution of respondent answers for each indicator, average scores, and interpretations of these values. Descriptive analysis will provide a clear overview of how both variables function in the strategic and operational context of ALKI II. These results will form the basis for developing strategic recommendations to enhance command and control effectiveness and strengthen maritime security in the region.

Reliability testing in this study was assessed using Cronbach's alpha and composite reliability. The analysis results showed that both variables had good reliability with values ≥ 0.7. This indicates that the instruments used in this study were consistent in measuring the intended variables.

Additionally, validity testing was conducted based on the loading factor and average variance extracted (AVE). AVE values obtained ≥ 0.5 indicate that all question instruments from both variables have good validity. This convergent validity shows that latent variables can interpret half of each indicator; thus, convergent validity is considered good (Ghozali, 2014; Hair et al., 2017). Researchers also conducted a validity test using the Fornell-Larcker criterion, which is a measure to compare the square correlations between variables derived from AVE calculations. This test was intended to prove that the square root of constructs has greater indicator values compared to correlations with other constructs (Hair et al., 2017; Anjel et al., 2022).

Hypothesis testing in this study used a significance level of $p < 0.05$ to determine whether the null hypothesis (H_0) could be rejected. Additionally, direct and mediating effects were measured using the Effect Size F Square value, with the following criteria: 0.02 indicates a low effect, 0.15 indicates a moderate effect, and 0.35 indicates a high effect (Hair et al., 2017).

5. Results And Discussion.

5.1. Descriptive Analysis.

Table 1 below shows the results of the analysis of the command and control effectiveness variable and the maritime security variable based on statistical data.

Based on the descriptive analysis table above, for the variable of Command and Control Effectiveness (CCE1), 3 respondents (1.0%) answered strongly disagree, 34 respondents (11.1%) answered disagree, 119 respondents (38.9%) answered somewhat agree, 107 respondents (35.0%) answered agree, and 43 respondents (14.1%) answered strongly agree. The analysis

Table 1: Descriptive Analysis of Research Variables.

Variable		1: Strongly Disagree		2: Disagree		3: Neutral		4: Agree		5: Strongly Agree		Average
		F	%	F	%	F	%	F	%	F	%	
Command And Control Effectiveness	**CCE 1**	3	1,0%	34	11,1%	119	38,9%	107	35,0%	43	14,1%	3,50
	CCE 2	3	1,0%	30	9,8%	125	40,8%	110	35,9%	38	12,4%	3,49
	CCE 3	6	2,0%	45	14,7%	114	37,3%	101	33,0%	40	13,1%	3,41
	CCE 4	3	1,0%	41	13,4%	113	36,9%	113	36,9%	36	11,8%	3,45
	CCE 5	6	2,0%	45	14,7%	113	36,9%	101	33,0%	41	13,4%	3,41
Maritime Security	**MS 1**	3	1,0%	7	2,3%	75	24,5%	124	40,5%	97	31,7%	4,00
	MS 2	3	1,0%	7	2,3%	69	22,5%	130	42,5%	97	31,7%	4,02
	MS 3	4	1,3%	4	1,3%	59	19,3%	123	40,2%	116	37,9%	4,12
	MS 4	4	1,3%	4	1,3%	75	24,5%	136	44,4%	87	28,4%	3,97
	MS 5	2	0,7%	21	6,9%	68	22,2%	132	43,1%	83	27,1%	3,89
	MS 6	4	1,3%	6	2,0%	68	22,2%	146	47,7%	82	26,8%	3,97

Source: Authors.

of the Command and Control Effectiveness variable shows the strongest emphasis on the speed of obtaining a comprehensive situational picture, while the weakest is in the speed of information distribution to operational units and information protection. Overall, the Command and Control Effectiveness variable has an average score of 3.45, indicating a fairly good level of support for strategic success.

For the Maritime Security variable (MS1), 3 respondents (1.0%) answered strongly disagree, 7 respondents (2.3%) answered disagree, 75 respondents (24.5%) answered somewhat agree, 124 respondents (40.5%) answered agree, and 97 respondents (31.7%) answered strongly agree. The analysis of the maritime security variable shows the strongest emphasis on maritime strength's ability to prevent sovereignty violations, while the weakest is in navigation security in ALKI II. Overall, the maritime security variable has an average score of 3.9, indicating the achievement of maritime security conditions as a goal of the strategy in a good state.

5.2. Reliability Test.

Table 2: Internal Consistency Reliability.

Variable	*Cronbach's Alpha*	*Composite Reliability*	Explanation
Command And Control Effectiveness	0.798	0.861	Reliable
Maritime Security	0.915	0.935	Reliable
***Composite Reliability > 0,70. Cronbach's Alpha > 0,70**			

Source: Authors.

From Table 4, it shows that the Cronbach's alpha and composite reliability values are ≥ 0.7. This indicates that the indicators within the Command and Control Effectiveness variable and Maritime Security variable above have good reliability with respect to their latent variables.

Table 3: Loading Factor Values and AVE.

Variable	Loading Values		AVE	Explanation
Command And Control Effectiveness	**CCE 1**	(0.737)	(0.743) Greater than the diagonal number	Valid
	CCE 2	(0.754)		
	CCE 3	(0.746)		
	CCE 4	(0.731)		
	CCE 5	(0.749)		
Maritime Security	**MS** 1	(0.875)	(0.840) Greater than the diagonal number	Valid
	MS 2	(0.902)		
	MS 3	(0.877)		
	MS 4	(0.875)		
	MS 5	(0.743)		
	MS 6	(0.753)		
**** Loading Value = >0.7, AVE = >0.50, Convergent Validity***				

Source: Authors.

This study used validity testing with Average Variance Extracted (AVE), which calculates the average squared loading of the construct indicators. Based on the table above, all question items from both variables have average loading values and AVEs greater than their diagonal values. Therefore, it can be concluded that all question items from the Command and Control Effectiveness variable and Maritime Security variable are valid. This indicates that these instruments accurately measure the intended constructs, and the measurement results can be relied upon for further analysis in this study.

Table 4: Fornell-Larcker Criterion.

	CCE	MS
CCE	0.743	0.558
MS	0.558	0.840
***AVE CCE = 0.743, AVE MS = 0.840, Correlation CCE, MS = 0.558**		

Source: Authors.

Based on Table 4, the AVE (average variance extracted) value for the Command and Control Effectiveness (CCE) variable is 0.743, and the AVE value for the Maritime Security (MS) variable is 0.840. Both of these values are greater than the correlation between CCE and MS, which is 0.558. This indicates that the CCE and MS variables have good discriminant validity. In other words, each construct is more capable of explaining its own variance compared to explaining the variance of other constructs.

Overall, these results support the validity of the measurement model in this study, meaning that the constructs used in this research can effectively differentiate themselves from each other. Good discriminant validity ensures that the measured concepts are truly distinct and do not overlap, thereby providing more confidence in the conclusions drawn from the data analysis.

5.3. Hypothesis Testing.

Table 5: Direct Hypothesis Estimation.

	Path Coefficient	P -Values	*F- square*
Command And Control Effectiveness → Maritime Security	0,150	0,01	0,19
**** Path Coefficient = -1 to 1. P-value = <0.05. F square = 0.02 low, 0.15 moderate, and 0.35 high***			

Source: Authors.

The results of this study indicate that command and control effectiveness has a positive influence on maritime security. Based on the direct hypothesis estimation table, the path coefficient of 0.150 with a p-value of 0.01 shows that the relationship between command and control effectiveness and maritime security is significant. The F-square value of 0.19 indicates that the impact of command and control effectiveness on maritime security falls into the moderate category. This means that while the contribution of command and control effectiveness to improving maritime security is not the most dominant, it is significant enough to be considered in efforts to manage maritime security in ALKI II.

Overall, these findings emphasize the importance of effective command and control in supporting and enhancing maritime security. With the ability to quickly and accurately obtain a comprehensive situational picture, analyze, evaluate, and distribute information, as well as protect information, maritime security operations can be more directed and responsive to various threats and challenges in the ALKI II region.

5.4. Command and Control Effectiveness Towards Maritime Security Achievement in ALKI II.

Based on the analysis and research findings, command and control effectiveness has been shown to have a positive and significant influence on achieving maritime security in ALKI II, Indonesia. This influence, albeit moderate with a value of 0.19, indicates that improvements in command and control aspects can have a meaningful impact on maritime security overall. These findings underscore the importance of command and control in the national maritime security strategy. The results are consistent with previous research emphasizing the importance of information superiority, rapid analysis, and efficient information distribution in maritime operations (McDowell et al., 2024).

Further analysis reveals that the primary strength of the command and control system lies in its ability to quickly obtain a comprehensive situational picture (CCE1). This aligns with the thoughts of Doorey (2016) and Dayan (2024), who emphasize the importance of comprehensive understanding in maritime activities. However, there are weaknesses that need attention, particularly in the speed of information distribution to operational units and information protection. These aspects represent critical areas that require improvement to optimize command and control effectiveness as a whole.

Maritime security in ALKI II, especially in preventing sovereignty violations, is considered highly important by respondents. This indicates that security aspects are a top priority in maritime operations. However, navigation in ALKI II is still seen as a weak point requiring further attention. This highlights the need for improved infrastructure and technology to ensure better navigational safety. These findings emphasize the need for a more comprehensive and integrated approach to maritime security management, in line with McCabe et al. (2018) and Burns (2013) regarding the importance of collaboration among Navy components.

To enhance command and control effectiveness, improvements in information distribution speed and information protection are necessary. These measures could include investment in more advanced communication technology and ongoing training for maritime personnel. The success of the Indonesian Navy in achieving maritime security in the ALKI II region will support Indonesia's vision as a global maritime fulcrum. The effectiveness of the Indonesian Navy's command and control in ALKI II is not only important for national security but also has broader strategic implications. As highlighted by Suhirwan and Prakoso (2019), this is closely related to Indonesia's vision as a global maritime fulcrum. Therefore, efforts to enhance command and control effectiveness must be an integral part of the national strategy to strengthen Indonesia's position in the region.

Future maritime security challenges will become increasingly complex and will require rapid adaptation to changing conditions. This includes the ability to integrate new technologies and develop flexible strategies (Sotire, 2024). Collaboration among various naval components and other actors is also crucial for creating a comprehensive understanding of the maritime situation and optimizing resource utilization (Doorey, 2016).

Conclusions.

This study highlights the importance of command and control effectiveness in enhancing maritime security in ALKI II. The analysis results show that command and control effectiveness has a significant influence on maritime security, with a path coefficient of 0.150 and a significant p-value of 0.01. The obtained F-square value of 0.19 also indicates that the resulting influence falls within the moderate category according to established criteria. To achieve optimal maritime security, improvements in key aspects such as information distribution and information protection need to be considered. Sustained investment in the development of command and control systems will not only enhance maritime security in ALKI II but also support regional stability and Indonesia's vision as a global maritime fulcrum.

This study provides practical implications for maritime security policy in Indonesia, emphasizing the importance of integrating and responsive command and control systems in facing increasingly complex maritime security challenges. These findings can also serve as a foundation for further research to broaden our understanding of other factors influencing maritime security and to develop more holistic and effective strategies to maintain security in Indonesian waters.

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