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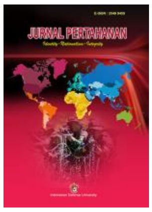

ANALYSIS OF THE CAPABILITIES OF PORTABLE MINE-HUNTING EQUIPMENT OF THE AUXILIARY MINE COUNTERMEASURE DIVISION TO SUPPORT THE SUCCESS OF AMPHIBIOUS ASSAULTS

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Abstract

Revolution in Military Affair (RMA) has encouraged technological developments in the field of mine warfare. Technological developments in the field of mine warfare have produced smart littoral mines, in which a threat that can thwart the implementation of amphibious assaults. This study tries to analyze the Auxiliary Mine Counter Measure (MCM) Division portable mine-hunting equipment capabilities to support the success of amphibious assaults. This study uses the Measurement of Effectiveness (MoE) and the Analytical Hierarchy Process (AHP) methods to measure capabilities and determine priorities for increasing the capability of portable mine-hunting equipment to support amphibious attack support. As a result, the equipment that rushes portable mines is an increase in support for amphibious assaults because it is incompatible with existing technological developments. To be able to support the spirit of the invasion, it is necessary to procure new equipment designed by following latest developments in mine warfare technology.

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INTRODUCTION

Revolution in Military Affair (RMA) originates from the way of thinking of the United States (U.S.) military circles which occur because of the emergence of technological developments triggered by technological advances. This development was adopted by the U.S. military where the country developed the concept of mine warfare based on the development of mine technology and changes in threats. U.S. is reviewing a new mine warfare strategy with the concept "Future Mine Countermeasures" with a focus on Mine Counter Measure (MCM) operations in littoral waters. Furthermore, since 1998, they have developed what is called "The Concept for Future Mine Countermeasures in Littoral Power Projection" (Tangen, 2009)). The concept is based on modern littoral mines which are designed in such a way that their shape, dimensions, weight, explosive capability, and sensors have various advantages so that they cannot be detected by Mine Counter Measure ship mine-hunting equipment equipped with both hunting sonar and portable mine-hunting equipment. Littoral mines are a threat to the implementation of Marine Operations, one of which is Operation Amphibious.

In Figure 1, it can be explained that the types of obstacles and littoral mines that are present in the littoral area greatly affect the amphibious operations to be carried out in the form of littoral mines such as base mines, anchor mines, and floating mines. An amphibious operation is a military operation launched from the sea by naval and landing forces embarked in ships or craft involving a landing on a hostile or potentially hostile shore (Boose, 2008). The development of mine technology in the littoral sea can hinder the operation of Amphibious Operations because it can thwart Amphibious Invasio n with the presence of anti-invasion mines or littoral mines. The task of countering these littoral mines is carried out by the Mine Warfare Unit which carries out the MCM on amphibious assaults, one of which is the Auxiliary MCM Division. The discussion in this study is the Auxiliary MCM Division mine-hunting equipment used for the implementation of MCM activities against littoral mines to support the success of amphibious raids.

The portable mine-hunting equipment owned by the Auxiliary MCM Division is largely behind in terms of mine warfare technology, especially in operations against today's modern littoral mines which are still

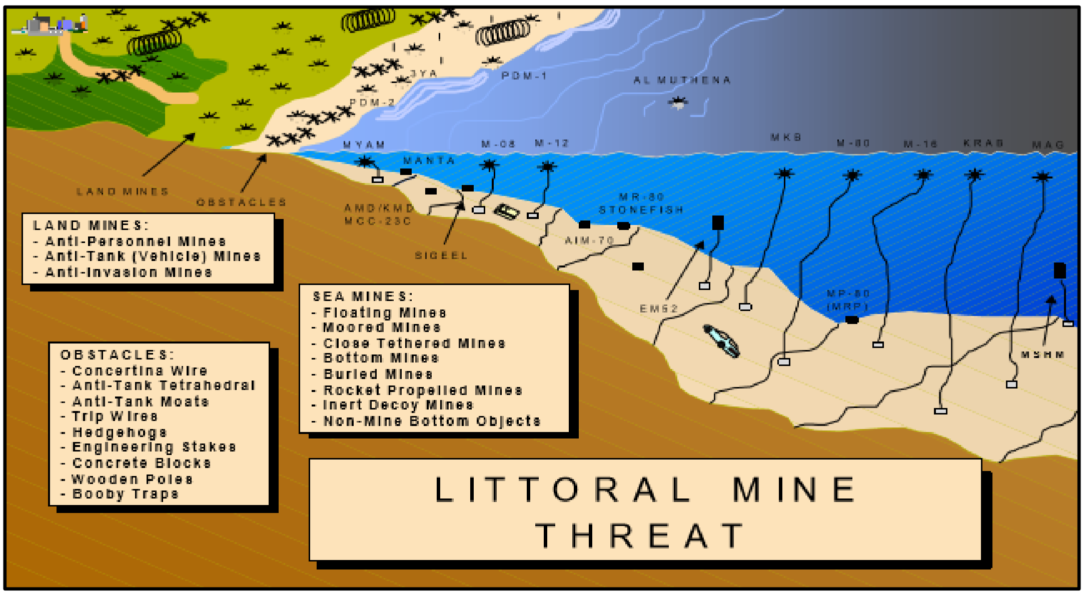

Figure 1. Types of Obstacles and Littoral Mines
Source: U.S. Chairman of the Joint Chiefs of Staff, 2009

manually operated. This study aimed to analyze the ability of the Auxiliary MCM Division portable mine-hunting equipment in dealing with littoral mines and to determine priorities for enhancing the capabilities of the equipment to support the success of amphibious assaults.

A conceptual design was proposed for an effective MCM system, consisting of three unmanned underwater vehicles (UUV) and several small vehicles that could be delivered. A new underwater optical communication system was introduced to improve marine mine reconnaissance and decision making with key technologies focusing on system and communication efficiency, data processing capabilities, and MCM system cost-effectiveness. The proposed MCM of the UUV system is cost-effective because it adapts disposable mine neutralization instruments, improves data processing units, and configures optical communication systems between underwater vehicle units and heterogeneous surfaces in operation. At the same time, efficient and reliable underwater optical and electromagnetic wave communication systems were also introduced and analyzed for future system applications (Sub Song & Chu, 2012).

The relevance between this research and the research conducted is in terms of analysis of MCM capabilities faced with the capabilities of MCM equipment and the effectiveness of MCM capabilities. This is following the research conducted in the aspect of analyzing the capabilities of portable mine-hunting equipment owned by the Auxiliary MCM Division to support the success of amphibious assaults.

METHODS

This study uses a quantitative method, which is a process of finding that uses data in the form of numbers as a tool to analyze what information you want to know (Kasiram, 2010). In this study, 2 (two) variables were consisting of the ability of portable mine-hunting equipment and the success of amphibious attacks. While the determined population consists of soldiers of the third Division who serve in the Warship Unit.

From the existing population, 25 samples were taken as respondents. The statements conveyed by the 25 respondents in the interviews and questionnaires distributed by the researcher are the primary data in this study. This amount is determined using the Slovin formula, as follows:

$$n = \frac{253}{(1 + 253(0{,}2)^2)} = 24{,}9 = 25 \text{ sample}$$

Meanwhile, secondary data in this study came from the third Division and Warship Unit which was designated as population. The data used as secondary data are shown in Table 2. The data obtained were then analyzed using the Measurement of Effectiveness (MoE) and the analytical Hierarchy Process (AHP) methods. The MoE method, according to Smith and Clark (2006), is used to measure the effectiveness of a system to achieve specified mission requirements. The MoE method in this study aims to calculate the effectiveness of the ability of portable mine-hunting equipment in dealing with littoral mines to support the success of amphibious assaults.

While the AHP method is a functional hierarchy with the main input being human perception (Saaty, 2000). This method was developed by Prof. Thomas Lorie Saaty from Wharton Business School in the early 1970s to find a ranking or priority order of various alternatives in solving a complex problem in a multi-level structure where the first level is the goal, followed by the factor level, criteria, sub-criteria, and so on. Down to the last level of the alternatives (Saaty, 2000). AHP method is used to decide what capabilities are prioritized in dealing with littoral mines among the capabilities of portable mine-hunting equipment.

In solving problems with AHP, several principles must be understood, namely: (1) Decomposition (creating a hierarchy), which is breaking a complex system into

Table 1. Total Population

Unit	Warship Unit			Population Size
Number of Population	Officer	NCO	Rating	
253	49	98	106	253

Source: Warship Unit, 2020

Table 2. Secondary Data

No	Unit	Population Size
1	The Third Division	a. Technical data of portable mine-hunting equipment b. Technical condition of portable mine-hunting equipment c. Maintenance and repair history of portable mine-hunting equipment d. Operation and exercise history
2	Warship Unit	a. Technical condition of portable mine-hunting equipment b. Maintenance and repair history of portable mine-hunting equipment c. Operation and exercise history

Source: Processed by Author, 2020

smaller elements to make it easier to understand, (2) Comparative judgment or evaluating criteria and alternatives with paired comparisons. so that the importance scale of each criterion against the other criteria can be found, (3) Synthesis of priority or determining priority, and (4) Logical Consistency or logical consistency. Decision making using the AHP method is based on the following steps:

a. Defining the problem and determining the desired solution, then arranging a hierarchy of the problems at hand
b. Determining the priority of the elements begins with making a comparison of the pairs, namely the evidence of the use of battleship A battleship and comparing the elements in pairs according to the given criteria. Furthermore, the pairwise comparison matrix is filled using numbers to represent the relative importance of one element to another.
c. Synthesis. Considerations for pairwise comparisons are synthesized to obtain overall priority. The things that are done in this step are:
   1) Add up the values of each column on the matrix.
   2) Divide each value from the column by the total column in question to obtain the normalized matrix.
   3) Add up the values from each row and divide by the number of elements to get the average value.
d. Measure Consistency. In making decisions, it is important to know how good the consistency is. The things that are done in this step are:
   1) Multiplying each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element, and so on,
   2) Add up each line,
   3) The sum of the rows divided by the corresponding relative priority element,
   4) Adding the quotient above with the number of elements present, then the result is called λ max.
e. Calculating the Consistency Index (CI) with the formula CI = (λmax - n) / n, where n is the number of elements.
f. Calculating the Consistency Ratio (CR) with the formula CR = CI / IR, where CI is the Consistency Index and IR is the Random Consistency Index.
g. Check hierarchy consistency. If the score is more than 10%, then the data judgment must be corrected. However, if the Consistency Ratio (CI / CR) is less or equal to 0.1, then the calculation results

Table 1. Random Index Value

n	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RI	0	0	0,58	0,90	1,12	1,24	1,32	1,41
n	9	10	11	12	13	14	15	
RI	1,45	1,49	1,51	1,53	1,56	1,57	1,58	

Source: Saaty, 2000

can be declared correct, the RI value or random index can be seen in Table 3.

RESULT AND DISCUSSION

The development of mining technology in littoral waters can hamper the operation of Amphibious Operations because it can thwart amphibious attacks with the presence of anti-invasion mines or littoral mines. Amphibious assault is one of the most important stages in the operation of Amphibious Operation. The success of an amphibian attack depends on several factors, including (Boose, 2008):

a. Amphibious assault fields are certain sea and land areas in the target area selected to meet tactical needs and to facilitate control of the movement of landing craft to shore which is the organization of the landing area.
b. Amphibian invasion obstacles are obstacles faced by the Amphibian Invasion divided into two, namely:
   1) Natural obstacles. Natural obstacles such as hydro-oceanography, coral reefs, and shoals.
   2) Artificial obstacles. Artificial obstacles are anti-landing and anti-vehicle obstacles (conventional and improvised), and minefield (anti-invasion mines and littoral mines).
c. Amphibious Clearance is a neutralization activity against obstacles and minefields in the Amphibious Attack Field carried out by MCM divers.

Faced with the current development of littoral mine technology and the task demands to support the success of amphibious assaults, it is hoped that the third Division will be able to support the success of amphibious assaults faced with littoral mines that are used as anti-landing mines. To support the success of the amphibious assault, researchers will carry out an analysis of the capability of the third Division portable mine-hunting equipment to support the success of the amphibious assault.

For this study, researchers have determined the research subject, namely the third Division Battleship Unit, while the object of research is the ability of the Division's portable mine-hunting equipment to support the success of amphibious assaults. Analysis of the capability of portable mine-hunting equipment to support the success of amphibious assaults was carried out using the Measurement of Effectiveness (MoE) approach. Here the values are determined based on the results of filling out a questionnaire by the respondents to determine the effectiveness of the components to be measured. The effectiveness values are as follows:

Very Ineffective (VI) = 0
Ineffective (I) = 0.25
Doubt (D) = 0.5
Effective (E) = 0.75
Very Effective (VE) = 1

Meanwhile, the components in portable mine-hunting equipment that will be measured for their effectiveness include five things, namely preparation, detection, identification, classification, and destruction. The results can be seen in Table 4. When arranged in a hierarchical diagram, the recapitulation of the effective value of the portable mine-hunting equipment components will look as can be seen in Figure 2. The weight value of each item is multiplied by the value of the effectiveness of each item down the hierarchical line.

Next, calculate the effective value of

Table 4. Recapitulation of Effectiveness value portable mine-hunting equipment

	VI	**I**	**D**	**E**	**VE**	**Respondents**	**Total value**	**Effectiveness value**
	0	0,25	0,5	0,75	1			
Preparation	2	7	2	14	0	25	13,25	0,53
Detection	5	4	2	13	1	25	12,75	0,51
Identification	5	5	1	13	1	25	12,5	0,5
Classification	7	5	6	5	2	25	10	0,4
Destruction	6	6	2	9	2	25	11,25	0,45

Source: Processed by Authors, 2020

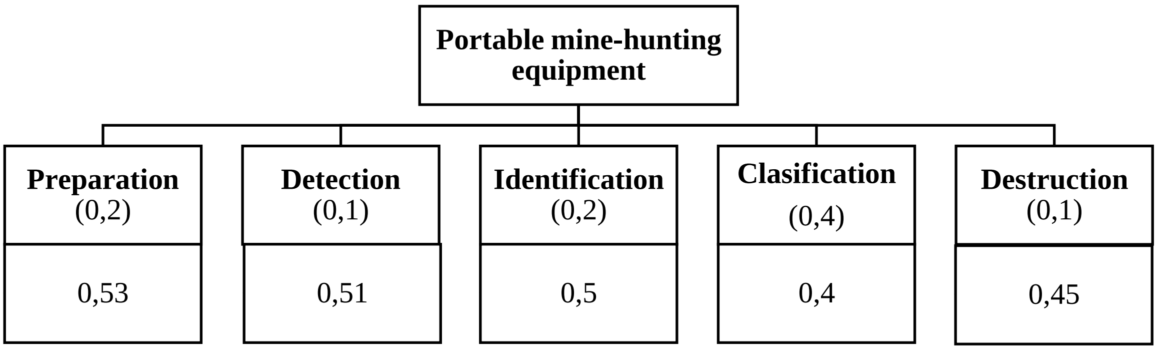

Figure 2. Hierarchy Diagram of Effectiveness Values Comp
Source: Processed by Authors, 2020

Table 5. MoE Value

Weighted Value				
	Component of Measure	**More Specific Component**	**Effectiveness Value**	**Total Value**
Portable mine-hunting equipment	0,5			
Preparation		0,2	0,53	0,053
Detection		0,1	0,51	0,0255
Identification		0,2	0,5	0,05
Classification		0,4	0,4	0,08
Destruction		0,1	0,45	0,0225
Total				**0,231**

Source: Processed by Authors, 2020

MoE with the formula: Mo MoE = (weight of portable mine-hunting equipment x weight of preparation x value of effectiveness) + (weight of portable mine-hunting equipment x detection weight x value of effectiveness) + (weight of portable mine-hunting equipment x weight of classification x value Effectiveness) + (Weight of portable mine-hunting equipment x Identification Weight x Effectiveness Value) + (Weight of portable mine-hunting equipment x Destruction Weight x Effectiveness Value). Therefore, the results of the MoE value of portable mine-hunting equipment is 0.231, as can be seen in Table 5. By the determined effectiveness value, the portable mine-hunting equipment is categorized as ineffective against littoral mines to support the success of amphibious assaults. After obtaining an MoE value which states that portable mine-hunting equipment is ineffective against littoral mines to support the success of amphibious raids, then an analysis is carried out using the AHP method to determine options from several alternatives that can be taken, namely (1) maintaining portable mine-hunting equipment that has been there are (2) modernization of portable mine-hunting equipment, or (3) procuring new portable mine-hunting equipment.

In using the AHP method questionnaire, there are criteria, alternatives, and values that the respondent must choose, namely: Moderate=1, Important=2, Very important=3, Absolute important=4. The result from 25 respondents:

1. New Procurement: as many as 10 respondents stated that it was 'Absolutely Important' (AI), then 11 respondents said it was 'Very Important' (VI), 2 respondents said it was 'Important' (I), and 2 respondents said it was 'Moderate' (M).
2. Modernization: 2 respondents stated that it is 'Absolute Important' (AI), then 20 respondents said it was 'Very Important' (VI), 2 respondents said it was 'Important' (I), and 1 respondent said it was 'Moderate' (M). 3. Maintaining: as many as 5 respondents said it was 'Absolute Important' (AI), then 9 respondents said it was 'Very Important' (VI), 2 respondents said it was 'Important' (I), and 2 respondents said it was 'Moderate' (M).

From Table 6, it appears that the ranking of alternatives based on the alternative criteria for portable mine-hunting equipment obtained from the questionnaire, rank 1 is the new procurement of portable mine-hunting equipment, rank 2 is the modernization of portable mine-hunting equipment, and rank 3 is maintaining portable mine-hunting equipment. After determining the CR (Consistency Ratio) value of these alternatives by squaring the matrix and normalizing it, the CR is 0.0157713. Meanwhile, the requirement for good consistency is that the CR is not more than 0.1. In other words, consistency can be stated as good.

Ranking of alternative actions for portable mine-hunting equipment. From the analysis using the AHP method, priorities that must be done to deal with littoral mines to support the success of amphibious invasions based on predetermined alternatives and criteria are obtained a priority ranking, as follows:

1. Rank 1. New procurement of portable mine-hunting equipment with a final rank of 0.62.
2. Rank 2. Modernization of portable mine-hunting equipment with a final rank value of 0.27.
3. Rank 3. Maintains portable mine-hunting equipment with a final rank of 0.11.

From this description, it can be stated that the capability of portable mine-hunting equipment is in the ineffective category. The effectiveness value of the portable mine-hunting equipment capability based on the results of data processing using the MoE method is 0.231. Based on data collected from sources, for portable mine-

Table 6. Ranking of alternative criteria for portable mine-hunting equipment

Criteria	Moderate (M)	Important (I)	Very Important (VI)	Absolute Important (AI)	Final Score	Norm	Norm X 100 %	Rank
Score	1	2	3	4				
New procurement	2	2	11	10	79	0,3607	36	1
Modernization	1	2	20	2	73	0,333	33	2
Maintains	2	9	9	5	67	0,306	31	3

Source: Processed by Authors, 2020

hunting equipment, the highest weight value is 0.5. This is natural because the role of portable mine-hunting equipment in a mine operation is very important at every stage of MCM activity. The capability of portable mine-hunting equipment is ineffective because upgrades are not carried out by existing technological developments where the technology is lagging behind current developments in littoral mines. The ability of portable mine-hunting equipment in mcm activities when the amphibious assault is not capable of dealing with littoral mines which on average are included in smart mines as it is today. The ability of portable mine-hunting equipment at each phase of MCM activity has not been optimal in detecting to destroying these littoral mines. The need for high-tech portable mine-hunting equipment in the MCM activity stage is very high, whereas currently, the portable mine-hunting equipment owned by the Third Division as one of the units involved in supporting the success of amphibious assaults has lagged behind the development of existing littoral mines.

According to the capability theory (Gibson, Ivancevich, Donnelly, & Konopaske, 2012) states that a capable ability to carry out tasks according to their respective fields and jointly according to objectives, namely in the implementation of MCM in amphibious raids by the third Division, one of which is supported by the ability of portable mine-hunting equipment. Increasing the capability of portable mine-hunting equipment in dealing with smart littoral mines will also have to be followed by improvements or changes in tactics and strategies that are tailored to the increased capability of the portable mine-hunting equipment.

Increasing the capability of portable mine-hunting equipment in dealing with littoral mines must also be followed by changes in tactics or improvements and strategies adapted to the enhancement of the capability of portable mine-hunting equipment. These steps are important to take so that all the dangers and damage caused by mines to ships and personnel can be prevented.

Based on the available alternatives, an increase in the capability of portable mine-hunting equipment that must be done is to procure portable mine-hunting equipment with the latest technology of portable mine-hunting equipment so that it can deal with littoral mines to support the success of amphibious attacks.

This statement is consistent with the elaboration in the book Multinational Tactical Publication-6 (C) (MTP-6 C) Vol. I on Naval Mine Warfare Principles (NATO, 2016b), Multinational Tactical Publication-6 (C) (MTP-6 C) Vol. II on Naval Mine Countermeasures Operations Planning and Evaluation (NATO, 2016a), and MTP-24 (C) on Naval Mine Countermeasures - Tactics and Execution (NATO, 2016b). There, it is explained that Mine Countermeasures (MCM) include all measures for countering mines by reducing or preventing danger or damage to ships and personnel mines against both ships and personnel). In their implementation, these efforts include all methods of preventing mines that have not been deployed as well as for combating mines that have been spread, including sweeping and mine hunting.

According to Kwang Sub Song and Peter C Chu (2012), the procurement of new portable mine-hunting equipment with operational capabilities that have requirements including being able to carry out MCM operations independently, being able to neutralize mines quickly and accurately, and having the ability to implement MCM and integrated into UUV and ROV equipment capable of operating far into enemy minefields that cannot be reached by warships due to hydrographic factors and attack threat factors from the opponent's coastal defense system where the portable mine-hunting equipment can detect underwater contact with various types of seabed without endangering the amphibious operation that will be implemented (Sub Song & Chu, 2012).

CONCLUSIONS, RECOMMENDATION, AND LIMITATION

Based on the MoE value, the ability of portable mine-hunting equipment to support amphibious attacks based on the results of data processing that has been done is not yet effective.

This study carried out an analysis that currently the Third Division portable mine-hunting equipment still uses manually operated equipment with towing using lifeboats, so it requires a lot of personnel and time in carrying out its operations where this technology is far behind with the development of current littoral mines which are a threat. in the implementation of amphibious assaults. The development of littoral mines now that has reached a smart mine where mines can select targets precisely and accurately cannot be faced by the Third Division portable mine-hunting equipment starting from the operational phase of preparation, detection, classification, identification to destruction or neutralization.

To increase the capability of the Third Division's portable mine-hunting equipment to support the success of amphibious assaults based on the results of data processing using the AHP method, the results are that it is necessary to procure new portable mine-hunting equipment. The new portable mine-hunting equipment is expected to have operational capabilities with requirements including being able to carry out MCM Operations independently, be able to neutralize mines quickly and accurately, and can implement MCM and be integrated into UUV and ROV equipment capable of operating far to the minefield area. Unable to be reached by mine hunting vessels due to hydrographic factors or attack threat factors from the opponent's coastal defense system where the portable mine-hunting equipment can detect underwater contact with various types of seabed without endangering the amphibious operation to be carried out.

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