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STRENGTHENING MARITIME DEFENSE: A NEW APPROACH TO THE DISTRIBUTION OF WEAPONS AND AMMUNITION TO SAFEGUARD INDONESIA'S MARITIME SOVEREIGNTY

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ABSTRACT
In the ongoing era of globalization, maritime defense has increasingly become a crucial aspect for various nations, particularly for Indonesia with its vast maritime territory. The Indonesian Naval Arsenal (TNI AL) serves not only as a storage facility for weapons but also as a strategic center responsible for managing inventory, ensuring reliability, and facilitating the smooth operation of maritime defense. The accuracy of location and efficiency in the weapons loading process for the Republic of Indonesia Navy (KRI) is paramount; KRI vessels based near Arsenal Batuporon in Koarmada II have a significant advantage, while those from Koarmada I and III face challenges in weapon loading. One proposed solution is the construction of additional arsenals in the western and eastern regions of Indonesia. This research aims to analyze the determination of new Arsenal locations, develop a decentralized weapons distribution model, and compare the efficiency between centralized and decentralized distribution models. The findings of this study are expected to provide deeper insights into weapon distribution strategies to support the readiness and reliability of the Indonesian Navy in safeguarding the country's maritime sovereignty and ensuring law enforcement against increasingly complex and varied maritime violations.

KEY WORDS
Maritime defense, TNI AL arsenal, weapon distribution, operational readiness.

In this era of globalization, maritime defense plays an increasingly important role in safeguarding a nation's sovereignty. Especially for Indonesia, which has vast and strategic maritime territories, the importance of maritime defense cannot be overlooked. One key element in logistical preparation to ensure operational readiness in facing various challenges at sea is the Indonesian Navy Arsenal. This arsenal serves not only as a storage facility for weapons and ammunition but also as a strategic center managing supplies, maintaining reliability, and ensuring the smooth operation of maritime defense.

The accuracy of location and efficiency in the process of loading weapons and ammunition for the Indonesian Republic Warships (KRI) is a crucial factor in determining operational readiness. KRIs based near the Batuporon Arsenal, such as those in the Second Fleet Command (Koarmada II), gain significant advantages. This condition facilitates the rapid loading of weapons and ammunition, thus saving time, fuel, and food supplies during operations. However, KRIs from the First and Third Fleet Commands (Koarmada I and III) face significant challenges due to their distance from the Arsenal. They encounter difficulties in loading weapons and ammunition, which can hinder strategic decision-making in the field. Efforts are needed to improve access to efficient loading facilities or design alternative logistic strategies to comprehensively address this issue and enhance operational capabilities in all fleet divisions.

To address the challenges faced in the distribution of weapons and ammunition, the proposed solution is to build additional Arsenals in the western and eastern regions of Indonesia. The construction of additional Arsenals is expected to significantly improve the efficiency of distributing weapons and ammunition to Indonesian Republic Warships (KRI). Therefore, the main objective of this research is to conduct a comprehensive analysis to determine the appropriate locations for the construction of new Arsenals. Thus, this research is expected to make a real contribution to enhancing the operational readiness of KRIs and strengthening the overall defense of the country.

In addition to determining the optimal locations, this research will also focus on developing a decentralized model for the distribution of weapons and ammunition. This model will be designed to ensure that the supply of weapons and ammunition can be efficiently distributed throughout the Indonesian waters. The research will compare the efficiency between centralized and decentralized distribution models to evaluate which one is more suitable for the operational needs of the Indonesian Navy. Thus, it is hoped that this research will provide valuable insights into improving an adaptive and responsive weapons and ammunition distribution system to the military operational dynamics in Indonesian waters.

Through this approach, it is expected that this research will provide deeper insights into weapon and ammunition distribution strategies that can enhance the readiness and reliability of the Indonesian Navy in safeguarding the sovereignty of Indonesian waters. With a better understanding of the appropriate locations and efficient distribution models, concrete steps can be taken to strengthen Indonesia's maritime defense and improve the effectiveness of enforcement against increasingly complex and varied violations at sea.

By adopting new approaches in the distribution of weapons and ammunition, it is hoped that Indonesia's maritime defense can be significantly strengthened. This will not only ensure the smooth operation of maritime defense but also enable more effective enforcement against increasingly complex and varied violations at sea. Thus, the overall maritime security of Indonesia will be enhanced, which in turn will contribute positively to regional stability and global security.

The research method used in this paper adopts a mixed-method approach, which includes quantitative and qualitative descriptive analysis. The quantitative approach begins with problem identification, data collection, data analysis, and reaching appropriate conclusions. Meanwhile, the qualitative descriptive approach, based on post-positivist philosophy, aims to objectively describe the situation with a focus on research questions of "who, what, where, and how." This study also utilizes in-depth interviews and historical analysis with the assistance of Excel add-in tools to gain deeper insights into weapons distribution.

RESULTS AND DISCUSSION

The Analytic Hierarchy Process (AHP), developed by Thomas L. Saaty, is a decision model tool. This model aims to simplify problems involving multiple factors or criteria into a hierarchical structure. According to Saaty (1993), a hierarchy is defined as the representation of a complex problem in a multi-level structure, starting from the goal at the first level, followed by factors, criteria, sub-criteria, and so on until the last level of alternatives. By using this hierarchy, complex problems can be divided into smaller groups, organized into hierarchical structures, making the problem appear more organized and systematically structured (Syaifullah, 2010).

AHP is often chosen as a problem-solving method for several reasons, including:

- The hierarchical structure allows the selection of criteria down to deeper sub-criteria levels;
- It takes into account the validity and tolerance of inconsistencies in the selected criteria and alternatives;
- It accommodates sensitivity analysis to evaluate decisions;
- AHP can be used by institutions and individuals, especially in policy research or priority strategy;
- Reliability lies in a well-organized structural process, ensuring priority setting is based on a logical process;
- AHP helps solve complex problems by structuring criteria hierarchies and analyzing considerations to develop weights or priorities.

AHP employs a functional hierarchy with the primary input from human perceptions. With this hierarchy, complex or unstructured problems can be broken down into smaller sub-problems and organized into a hierarchical form (Kusrini, 2007).

The AHP procedure involves three main principles: Decomposition, Comparative Judgment, and Logical Consistency. The steps are as follows:

- Problem decomposition: Goals are systematically broken down into a structure that can be achieved rationally;
- Assessment/weighting: Pairwise assessments are made for each element based on its relative importance;
- Matrix formation and Consistency Test: Weight normalization is performed by arranging pairwise matrices;
- Priority setting: Pairwise comparisons are made to determine alternative rankings. Weights are calculated through matrix manipulation;
- Synthesis of priorities: Local priority results and global criteria are used to determine global priorities at each level of the hierarchy;
- Decision-making: The best alternative is chosen based on the established criteria.

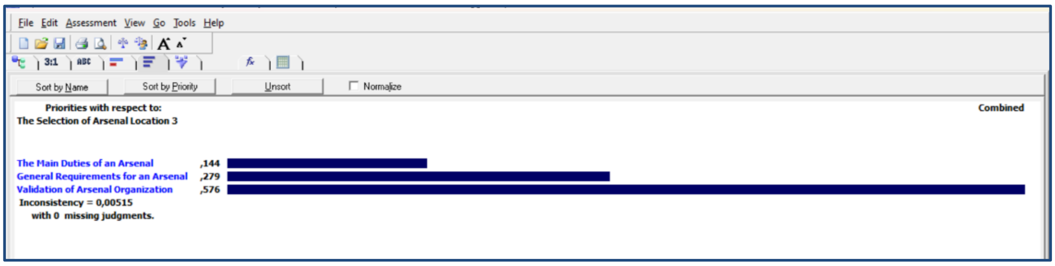

Figure 1 – Criteria for Selecting Arsenal Location 1
(Source: Data Processing Results with Expert Choice Software Ver. 11)

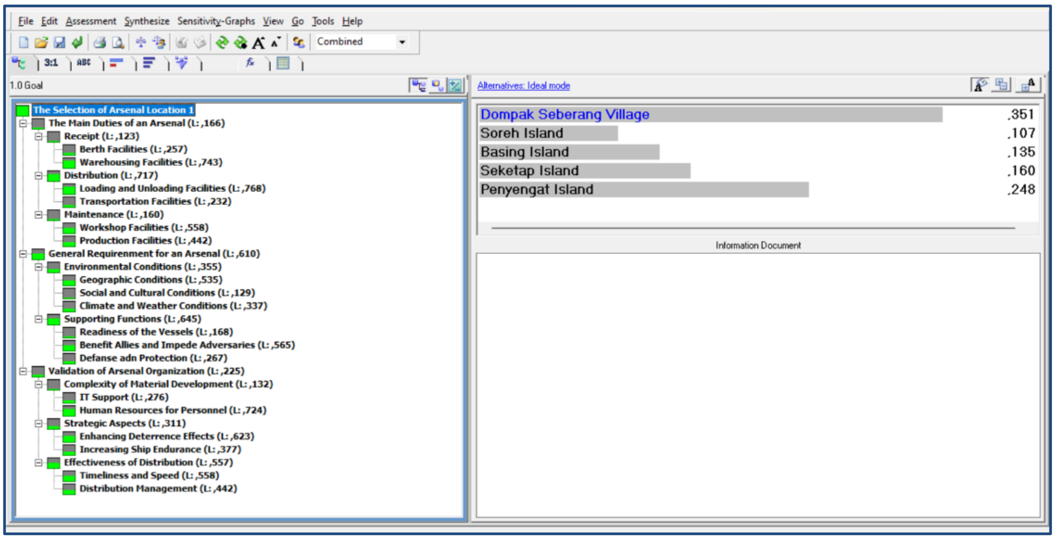

Figure 2 – Weight of Level 2 Criteria for Selecting Arsenal Location I
(Source: Data Processing Results with Expert Choice Software Ver. 11)

After obtaining the data, processing is carried out using the AHP method with the assistance of Expert Choice software version 11. The processed data consists of questionnaire results reflecting respondents' perceptions regarding the priority of determining strategic locations for the new arsenal around Fleet Command I and III. In Figure 1, the left column shows the criteria, sub-criteria, and sub-sub-criteria for selecting arsenal location I, while the right column represents the locations chosen as the location for arsenal I. Figure 2 shows the results of data processing with Expert Choice software ver. 11. At the criteria level for selecting Arsenal Location I, there are 3 types of criteria: Mission Criteria for Arsenal, General Requirements Criteria for Arsenal, and Validation Criteria for Arsenal Organization. The weight value for the Mission Criteria for Arsenal is 0.166, the weight value for the General Requirements Criteria for Arsenal is 0.610, and the weight value for the Validation Criteria for Arsenal Organization is 0.225. From the figure, it can be seen that the General Requirements Criteria for Arsenal is given more priority than the Mission Criteria for Arsenal and the Validation Criteria for Arsenal Organization in selecting Arsenal Location I.

From Table 1, it can be seen that the global weight values in determining the location of Arsenal I, as shown in Figure 3, are the results of data processing using Expert Choice software version 11. The global weight values in determining the priority of Arsenal I locations are as follows: Desa Dompak Seberang has a weight value of 0.351, Pulau Soreh has a weight value of 0.107, Pulau Basing has a weight value of 0.135, Pulau Seketap has a weight value of 0.160, and Pulau Penyengat has a weight value of 0.248. This indicates that Desa Dompak Seberang has the highest priority in selecting the location of Arsenal I because it has a greater weight than the other islands. The sequence can be seen in Table 1 and Figure 4.

Table 1 – Order of Global Weights for Determining Arsenal Location I

No.	Alternatif Arsenal I	Value
1	Dompak Seberang Village	0,351
2	Penyengat Island	0,248
3	Seketap Island	0,160
4	Basing Island	0,135
5	Soreh Island	0,107

Source: Data Processing Results with Expert Choice Software Ver. 11.

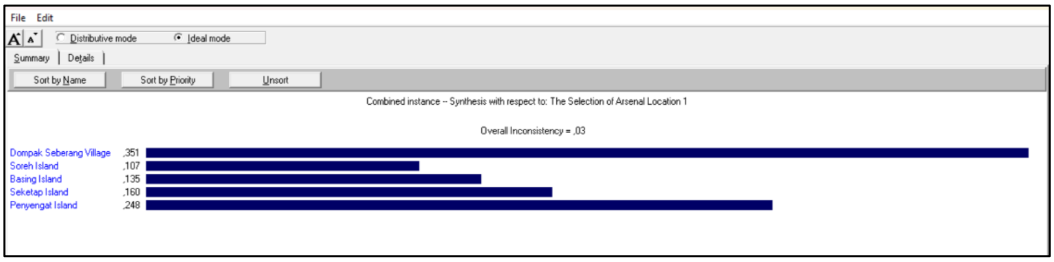

Figure 3 – Global Weight Chart for Determining Arsenal Location I
(Source: Data Processing Results with Expert Choice Software Ver. 11)

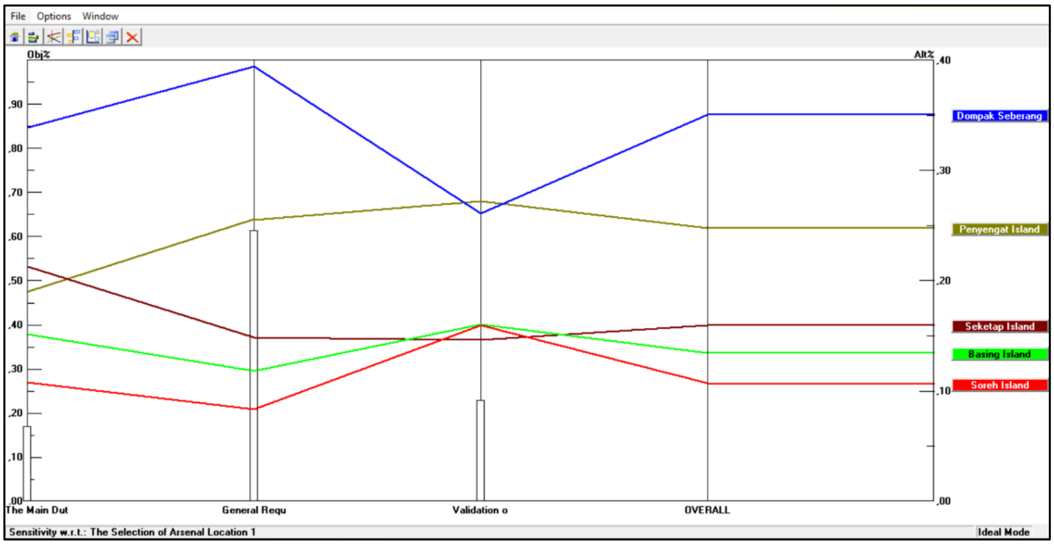

Figure 4 – Global Weight Chart for Determining Arsenal Location I
(Source: Data Processing Results with Expert Choice Software Ver. 11)

The greater the weight assigned, the higher the priority. Desa Dompak Seberang is considered the most crucial location in the context of selecting Arsenal Location I because its weight is significantly higher than other locations. This indicates that Desa Dompak Seberang has aspects or characteristics that are very important or strategic in the selection of Arsenal Location I. This location has better accessibility, abundant resources, or other factors that provide a significant competitive advantage. Therefore, in efforts to achieve optimal success, giving the highest priority to Desa Dompak Seberang is a wise step in selecting Arsenal Location I.Using the same data processing process as for Arsenal I location selection, Arsenal III was determined to have an ideal location on Pulau Makmak, Sorong, West Papua.

KRIs in Fleet Command I or Fleet Command III face significant challenges due to the distance to the current Arsenal in Madura. They have to transport their ammunition to the arsenal in Madura before conducting operations in their area, consuming valuable time and resources, disrupting budgets and supplies for operations. The lack of efficiency also poses difficulties for KRI Commanders in making strategic decisions, especially if ammunition supplies run out in distant operational areas. It is necessary to consider the optimal location for ammunition loading to save resources and provide flexibility in operational strategies. Centralized weapon storage also hampers efficiency, considering Indonesia's territory requires additional Arsenals to optimize ammunition distribution and maintain the readiness of the Indonesian Navy.

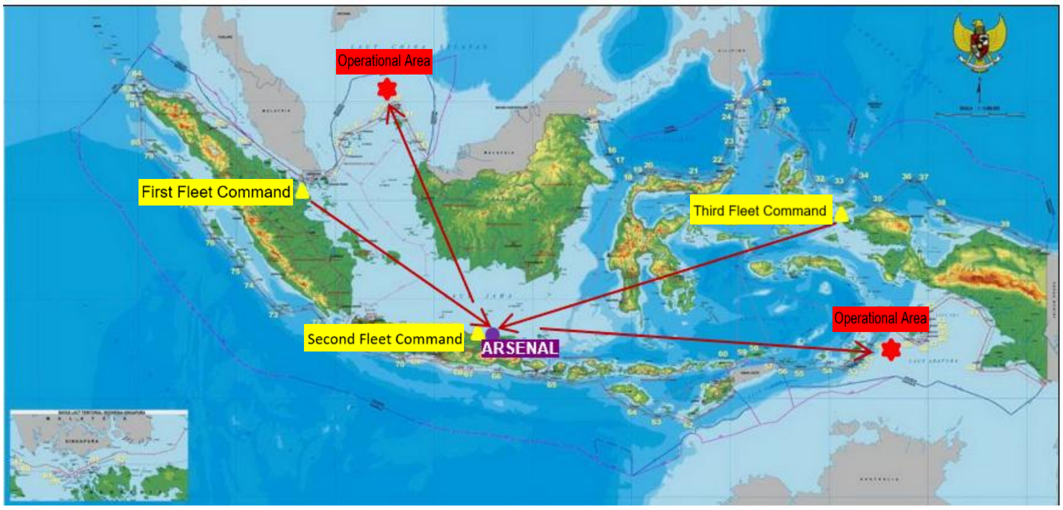

Figure 5 – Ammunition Distribution Supporting KRI Operations (Source: Processed by Researchers from the ammunition distribution mechanism at the Arsenal)

Ammunition distribution from the arsenal to the KRIs requires an effective and efficient distribution model. The first step in modeling is to determine the goals of physical ammunition distribution. In general, the distribution problem aims to minimize distribution costs, but in ammunition distribution, security and timeliness are of utmost importance. The minimized distribution costs include transportation costs related to the distance between the arsenal and the KRIs.

Centralized Ammunition Distribution Model (Model 1). The ammunition distribution model currently implemented by the arsenal is centralized distribution, where Arsenal Batuporon serves as the central storage and primary supplier of ammunition distributed directly to all Indonesian Navy KRIs, as shown in Figure 5.64. Before carrying out tasks in KRI operational areas, ammunition loading must be done at Arsenal Batuporon. Ammunition distribution is carried out by KRIs coming directly to Arsenal Batuporon.

When KRIs are conducting operations and require reloading, they must return to Arsenal Batuporon for refilling. The centralized distribution model enforces one-way delivery, meaning from the arsenal directly to the fleet. This results in ammunition distribution being solely carried out by the arsenal to the fleet. Therefore, the implementation of this centralized ammunition distribution model takes a long time and incurs significant costs.

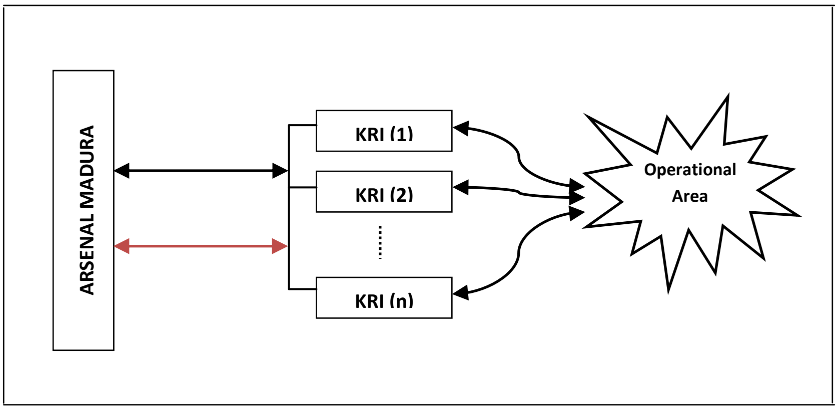

Figure 6 – Centralized Ammunition Distribution Model (Source: Processed by the Authors)

Alternative 1 Decentralized Ammunition Distribution Model (Model 2). In the decentralized distribution model alternative 1, there are three ammunition storage warehouses (Arsenal I, II, and III). The process of loading weapons, whether for KRIs from Fleet Command I, II, or III, can be carried out at any available warehouse (Arsenal I, II, or III). The process of reloading weapons is also similar, depending on the location of the KRI closest to which warehouse (Arsenal I, II, or III), with the same time for reloading at each warehouse.

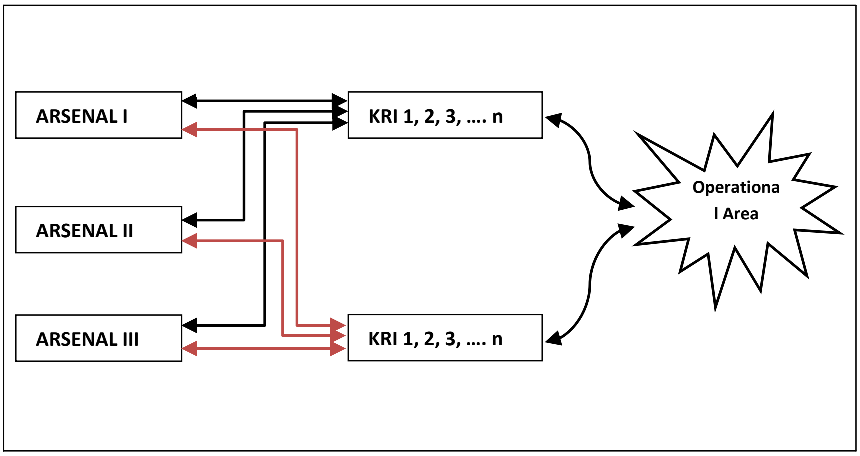

Figure 7 – Alternative 1 Decentralized Ammunition Distribution Model
(Source: Processed by the Authors)

In Alternative 1 Decentralized Ammunition Distribution Model, KRIs from any fleet are allowed to reload at any warehouse that suits operational needs and the availability of the nearest warehouse to the operational area.

Alternative 2 Decentralized Ammunition Distribution Model (Model 3). Alternative 2 Decentralized Ammunition Distribution Model comprises three arsenals tasked with supplying weapons to KRIs according to their respective fleet commands. Arsenal I is responsible for supplying weapons to KRIs in Fleet Command I, while Arsenal II and Arsenal III are responsible for supplying weapons to KRIs in Fleet Command II and Fleet Command III, respectively. The reloading process for KRIs is carried out in the same manner as the ammunition loading process.

Based on the cost calculations in the previous subsection, there are significant differences among the three models in overall ammunition distribution. In Model I, KRIs from any fleet must go to Arsenal II for ammunition loading before heading to the operational area, and reloading ammunition must also be done back at Arsenal II. In Model II, before KRIs depart for the operational area, ammunition loading for Fleet Command I is done at Arsenal I, for Fleet Command II at Arsenal II, and for Fleet Command III at Arsenal III. Reloading is conducted at the nearest arsenal to the operational area. In Model III, before KRIs depart for the operational area, ammunition loading is the same as in Model II, but for reloading, KRIs must return to their original arsenal. Assuming there are 12 KRIs of various types operating in Operational Area 1, the types of KRIs and the number of each type involved in addressing violations in Operational Area 1 can be seen in Table 2, for Operational Area 2 in Table 3.

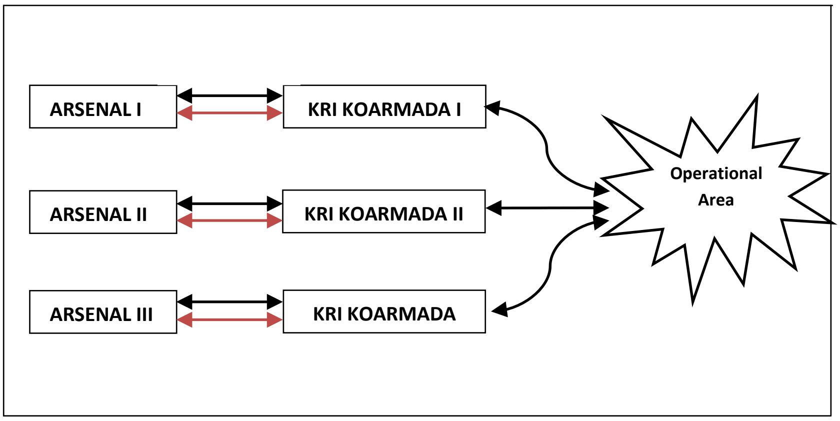

Figure 8 – Alternative 2 Decentralized Ammunition Distribution Model
(Source: Processed by the Authors)

Table 2 – Comparison of cost and time of distribution between existing conditions and recommended results in Operational Area 1

OBSERVED CONDITIONS	TYPES OF KRI	NUMBER OF KRI			TOTAL COST (Rp)	TIME (HOURS)
		FC I	FC II	FC III		
Model I	Striker	3	2	0	37.712.357.498,26	1.328
	Patrol	2	2	0	23.788.906.657,20	939
	Support	2	0	0	13.320.393.366,84	602
	Others	1	0	0	2.725.395.033,24	308
Total					77.547.052.555,54	3.177
Model II	Striker	3	2	0	17.604.203.795,84	620
	Patrol	2	2	0	11.917.106.247,60	470
	Support	2	0	0	4.283.594.490,84	201
	Others	1	0	0	911.814.860,88	103
Total					34.716.719.395,16	1.395
Model III	Striker	3	2	0	22.260.544.200,28	784
	Patrol	2	2	0	15.612.841.620,00	616
	Support	2	0	0	4.456.503.544,08	201
	Others	1	0	0	911.814.860,88	103
Total					43.241.704.225,24	1.705
The reduction between Model I and Model II					**42.830.333.160,38**	**1.782**
The reduction between Model I and Model III					**34.305.348.330,30**	**1.472**

Source: Processed by the Authors.

The calculation results indicate cost savings and time reduction obtained during the distribution of ammunition to the KRIs for sovereignty violation handling operations in Operational Area 1 by the KRIs from Fleet Command I and Fleet Command II, as listed in Table 2. The data shows that Model II is the choice with the most efficient cost and time compared to Model I or Model III. The savings obtained by comparing Model I with the least costly model, Model II, amount to Rp. 42,830,333,160.38, or if calculated as a percentage, the cost distribution savings reach 55.23%. Meanwhile, the total comparison of time required for ammunition distribution between Model I and Model II is also significant, saving up to 1,782 hours or 56.10%.

Table 3 – Comparison of cost and time of distribution between existing conditions and recommended results in Operational Area 2

OBSERVED CONDITIONS	TYPES OF KRI	NUMBER OF KRI			TOTAL COST	TIME (HOURS)
		FC I	FC II	FC II		
Model I	Striker	0	2	3	52.461.861.650,40	1.847
	Patrol	0	2	2	32.973.203.314,80	1.301
	Support	0	0	2	18.789.548.616,72	849
	Others	0	0	1	3.844.401.667,92	435
Total					108.069.015.249,84	4.432
Model II	Striker	0	2	3	31.799.609.188,52	1.120
	Patrol	0	2	2	21.402.156.553,20	949
	Support	0	0	2	8.319.977.069,60	340
	Others	0	0	1	1.702.293.885,60	170
Total					63.224.036.696,92	2.580
Model III	Striker	0	2	3	39.426.472.759,04	1.388
	Patrol	0	2	2	27.455.594.882,40	1.218
	Support	0	0	2	8.319.977.069,60	340
	Others	0	0	1	1.702.293.885,60	170
Total					76.904.338.596,64	3.118
The reduction between Model I and Model II					**44.844.978.552,92**	**1.853**
The reduction between Model I and Model III					**31.164.676.653,20**	**1.315**

Source: Processed by the Authors.

The calculation results indicate cost savings and time reduction obtained during the distribution of ammunition to the KRIs for sovereignty violation handling operations in Operational Area 2 by the KRIs from Fleet Command I and Fleet Command II, as listed in Table 3. The data shows that Model II is the choice with the most efficient cost and time compared to Model I or Model III. The savings obtained by comparing Model I with the least costly model, Model II, amount to Rp. 44,844,978,552.92, or if calculated as a percentage, the cost distribution savings reach 41.50%. Meanwhile, the total comparison of time required for ammunition distribution between Model I and Model II is also significant, saving up to 1,853 hours or 41.78%. The completion of this model uses the assistance of computational software Ms. Excel, ensuring that each distribution model formed can optimize KRI travel, reduce the required time, and ultimately optimally reduce distribution costs.

CONCLUSION

Considering the criteria for the main tasks to be carried out by the arsenal, the general requirements for the new arsenal, and the organizational validation required for the new arsenal, the determination of Arsenal I in Desa Dompak Seberang Tanjung Pinang and Arsenal III in Pulau Makmak Sorong Papua Barat would greatly support the distribution of ammunition to the fleets to become more effective and efficient.

The decentralized ammunition distribution model alternative II can be more effective and efficient compared to Model I (existing) and Model III by saving distribution costs in Operational Area 1 by 64.17% and in Operational Area 2 by 50.48%. Therefore, this selected model can support ammunition distribution effectively and efficiently.

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