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The application of AHP and PESTEL-SWOT analysis on the study of Military Amphibious Aircraft acquisition decision-making in Indonesia

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Abstract. Indonesia's characteristics as an archipelagic state along with the increase of traditional and non-traditional threats in Indonesia require the ownership of military amphibious aircraft to oversee its maritime territories and perform logistics distribution to remote areas with minimum accessibility, especially its outermost islands. This study applied a combination of analytic hierarchy process (AHP), Political, Economic, Social, Technology, Environment, and Legal (PESTEL) and Strength, Weakness, Opportunity, and Threat (SWOT) analysis to conduct a structured, systematic, measurable, and comprehensive decision-making process for selecting military amphibious aircraft and prescribe strategic recommendations on the acquisition plan. By

using 3 criteria, 14 sub-criteria, and 3 alternative aircraft models, the results of AHP analysis showed that the Beriev Be-200 aircraft are the most preferred aircraft by the Indonesian users. The results of PESTEL-SWOT analysis show that good diplomatic relations between Indonesia and the manufacturer's country of origin, users' support to the plan, and user's ability to adapt in operating and maintaining the aircraft support this decision. Meanwhile, limited fiscal capacity and domestic aircraft maintenance facilities/depots, as well as the risk of spare parts scarcity, have to be addressed for Indonesia to acquire its own military amphibious aircrafts.

Keywords. Military Amphibious Aircraft, Strategic Decision-Making, Defense Acquisition, Analytic Hierarchy Process (AHP), PESTEL-SWOT Analysis.

1. Introduction

Indonesia is an archipelagic country which consists of 17,504 islands and a coastline of 104,000 km [1]. With the enactment of the 1982 United Nations Conventions on the Law of the Sea (UNCLOS), Indonesia has a total land area of 1.9 million km² and 6.4 million km² waters that consist of 0.29 million km² of territorial sea, 3.11 million km² of archipelagic waters, and 3 million km² of Exclusive Economic Zone (EEZ) [2]. Indonesia is also located in a strategic position between two oceans, namely the Indian and Pacific oceans, as well as between two continents, namely Asia and Australia. Thus, Indonesia directly border with ten neighboring countries, namely Australia, Timor Leste, Papua New Guinea, Palau, the Philippines, Malaysia, Vietnam, Thailand, Singapore and India.

This unique geographical characteristic of Indonesia has several implications for national defense. First, Indonesia has 92 outermost islands and many other small islands with minimum accessibility but high importance for Indonesia's vital defense interests. In addition, the recognition of Indonesia as an archipelagic state with sovereign rights for the exploration, exploitation, management, and conservation of living and non-biological marine resources in accordance with UNCLOS 1982 come with several obligations that it must fulfil. Some of them are to protect its marine environment, ensure the safety of shipping activities in its waters, carry out law enforcement in its sovereign territory; and eradicate piracy, narcotics trafficking, and human trafficking [2].

The aforementioned conditions raise the importance of Indonesia's ability to oversee its waters and ensure good logistics distribution in its border territories and outermost islands for border and maritime defense purposes. Weak border control will increase vulnerability to external dangers and threats that can disrupt a country's national security [3]. Furthermore, various transnational threats in maritime domains from state, non-state, and state-sponsored actors are going in an increasing trend in the 21st century, which range from border territories violations, illegal, unregulated, and unreported (IUU) fishing, piracy, illegal trade, to marine pollution. In addition, the increasing shipping traffic in Indonesian waters also increases the risk of ship accidents or incidents at sea.

To deal with the aforementioned conditions, the ownership of defense capabilities to conduct various national defense missions is very important for Indonesia. One of them is military amphibious aircraft, namely aircraft with the capability to land and take off on water and land areas. During the Dutch East Indies colonial period, amphibious aircraft with capability to land and take off on water were used by the Military Aviation Service and the Dutch East Indies Navy to reach the outermost islands [4]. In Indonesia's military history, the Indonesian Air Force had also operated the PBY Catalina and Grumman UF-1 Albatross amphibious aircraft from the 1950s to the 1980s for various roles, ranging from transport to

search and rescue (SAR) missions. Indonesia had also chartered Beriev Be-200 amphibious aircraft several times from Russia to assist forest fire fighting missions, such as the forest fires that occurred in the remote areas in East Kalimantan in 1997 and those that occurred in Sumatra in 2015 [5].

Against the background, this study aims to provide strategic decision-making references and recommendations for defense sector policymakers on the acquisition of military amphibious aircraft to support various defense missions in Indonesia by employing a combination of several strategic decision-making methods. The strategic decision-making methods combination applied in this study are analytic hierarchy process (AHP) Political, Economic, Social, Technological, Environmental, and Legal (PESTEL) analysis, and Strength, Weakness, Opportunity, and Threat (SWOT) analysis. By employing these methods, this study was able to conduct a structured, systematic, measurable, and comprehensive decision-making process for selecting military amphibious aircraft and prescribe strategic recommendations on the military amphibious aircraft acquisition.

2. Literature Review

2.1. Defense Acquisition

In the context of defense sector, acquisition refers to the process of procuring goods and services from agencies outside the user organization to build an effective military capability [6]. In general, the external agency in question is defense industry that produces goods and services according to user needs and conducts procurement using a contract and regulations related to goods or services supply chain. The acquired goods are usually in the form of weapons or other required materials for defense purpose, while the acquired services are generally non-physical things required to develop military strength, such as consulting services, training and education, or supporting logistics.

Modern weapons systems have very complex characteristics, so careful planning and defense requirements definition are activities that must be carried out carefully in defense acquisitions. By doing so, the acquired weapons systems can be used effectively according to the requirements and avoid any implications that may arise subsequently. Therefore, the flow of the defense acquisition process is quite long, which includes the Concept, Assessment, Demonstration, Manufacture, In-Service, and Disposal (CADMID) stages [6].

In the Concept stage, various defense requirements are identified. Afterward, the Assessment stage is carried out to determine whether the requirement is urgent or important. The next stage is Delivery, where the requirements that have been determined are sent to the external agency who can meet these requirements and produce the first article if necessary. After being considered in accordance with the required specifications and approved, the next stage is Manufacturing or mass production of equipment in accordance with the requirements. After being produced, the equipment will be checked to ensure whether it can be used or not for further operation and maintenance by the user according to its useful life and terms of use (In-service stage). The last stage of the acquisition process is Disposal, namely sorting out the obsolete equipment to determine the most appropriate termination option for each equipment that is about to be discontinued. Based on the CADMID cycle above, there are at least three main aspects that need to be considered in making strategic decisions when acquiring a weapon system, namely the capabilities of the weapon system in relation to user needs, maintenance aspect, and the required costs to acquire, operate, and maintain the weapons systems.

2.2. *Military Amphibious Aircraft Capability*

One of the most important aspects in military amphibious aircraft acquisition is its ability to fulfill the operational requirements (Opsreq) that the users require. Opsreq refers to the users' requirement on the amphibious aircraft capability to function in supporting national defense missions, namely military operations of war and military operations other than war. The Law of the Republic of Indonesia Number 34 of 2004 on Indonesian Armed Forces states that military operations other than war consist of [7]:

- a. Dealing with armed separatism;
- b. Dealing with armed insurgency;
- c. Countering acts of terrorism;
- d. Securing border territories;
- e. Securing national strategic vital objects;
- f. Carrying out the duties of world peace in accordance with foreign policy;
- g. Securing the President and Vice President along with their families;
- h. Empowering defense territories and the supporting forces as early as possible in accordance with the total defense system;
- i. Assisting local government tasks;
- j. Assisting the Police in the framework of security and public order duties as regulated by law;
- k. Providing assistance in securing state guests at the level of heads of state and representatives of foreign governments that reside in Indonesia;
- l. Helping to cope with natural disasters impacts, evacuation, and humanitarian assistance provision;
- m. Assisting SAR mission; and
- n. Assisting the government in ensuring shipping and aviation security against piracy, armed robbery, and smuggling.

To support these military operations, military amphibious aircrafts are expected to have the following capabilities:

- a. Maritime patrol, namely the ability to conduct border reconnaissance, maritime reconnaissance, and law enforcement activities. Maritime patrols are not only conducted at sea to combat illegal fishing, but can also be at major rivers to combat timber theft by transnational crime organizations that take advantage of border control weaknesses. Maritime patrols can also be conducted to safeguard the 92 outermost small islands in Indonesia. Military amphibious aircrafts are more practical and effective in conducting maritime patrols.
- b. SAR. The ability of military amphibious aircrafts to land and take off on water makes them very suitable to be deployed as SAR aircraft in handling incidents or disasters that occur in the waters, such as sinking ships, disasters on small islands, shipwrecks, and airplane accidents at sea. Military amphibious aircrafts will be able to reach the target faster than other platforms, so that victims can be evacuated as quickly as possible and the death rate of victims can be reduced to a minimum level.
- c. Transport and deployment of personnel and goods. As a military transport aircraft, military amphibious aircrafts must be able to transport and support static and free falls for military and civilian personnel deployment.
- d. Medical evacuation. Military amphibious aircrafts can be used as a means of combat victims' medical evacuation as well as treating them during the trip. Military

amphibious aircrafts can also be used to evacuate victims in SAR missions, especially at incidents that occur at sea.

- e. Aerial photography and survey. Military amphibious aircrafts can take aerial photographs to obtain information or data for military or civilian purposes. Aerial photography activities can be combined with aerial mapping for survey purposes in natural resource exploration and intelligence activities.
- f. Water Bombing. Military amphibious aircrafts have the ability to take and drop large amount of water to support forest fire fighting operations or disturb enemies.
- g. Payload capability. Military amphibious aircrafts can be armed for defense purposes and enforcement activities against any forms of territorial violations, as well as to protect themselves.

2.3. Maintenance

Maintenance refers to a combination of all technical, administrative, and managerial activities during the life cycle of an item to maintain or return it to a state where it can perform its required function, namely the function or combination of functions of an item that is deemed necessary to serve its purpose or provide certain services [8]. In the context of aviation, maintenance is very important in ensuring the aircraft can perform its functions without interruption and ensuring flight safety. For this reason, aircraft owners carry out mandatory aircraft maintenance in accordance with the requirements in the international aviation safety regulations and the manufacturer's requirements. Aircraft maintenance requires skilled technicians and special instruments. It also has to meet the standards to ensure air traffic safety [9].

According to its nature, aircraft maintenance can also be classified into two types, namely corrective maintenance and preventive/predictive maintenance [10]. Corrective maintenance is performed after an aircraft equipment failure occurs, while preventive/predictive maintenance is scheduled on a regular basis. That is, corrective maintenance is generally performed when scheduling short-term maintenance (or short-term layovers); while preventive/predictive maintenance is carried out regularly in medium/long term operations.

The required aspects for a properly functioning maintenance system consist of maintenance planning (philosophy, workload estimation, capacity, and maintenance scheduling), maintenance organization (work design, standards, work measurement, and project administration) and control maintenance (work, materials, inventory, cost, and quality-oriented management) [11]. Based on these aspects, this study summarized the crucial aspects of maintenance that need to be considered in the selection of alternative military amphibious aircraft acquisitions, including the availability of spare parts, human resources capacity, maintenance facilities/depot capacity, availability of domestic and foreign maintenance service providers.

3. Research Method

This study employed a qualitative descriptive design using the combination of AHP, PESTEL, and SWOT as the data analysis techniques. To obtain the required data, this study collected primary data through interview and secondary data through questionnaire and literature review. Purposive sampling was opted as the sampling selection technique to determine the most suitable informants for interview and respondents for questionnaire based on the subjects' expertise and experience on military aviation in Indonesia. Interviews were conducted to several military officers in Indonesia with military aviation background to obtain

the required primary data for PESTEL and SWOT analysis. Meanwhile, the questionnaire was disseminated to seven subject matter experts that consist of practitioners in Indonesian military aviation for conducting data analysis using AHP. After collecting the required data, AHP and PESTEL-SWOT analysis were conducted concurrently to generate the result, draw conclusion, and propose strategic recommendation based on the result. Followings are the explanations on how each data analysis technique was employed in this study and how the validity testing was conducted for each data analysis technique.

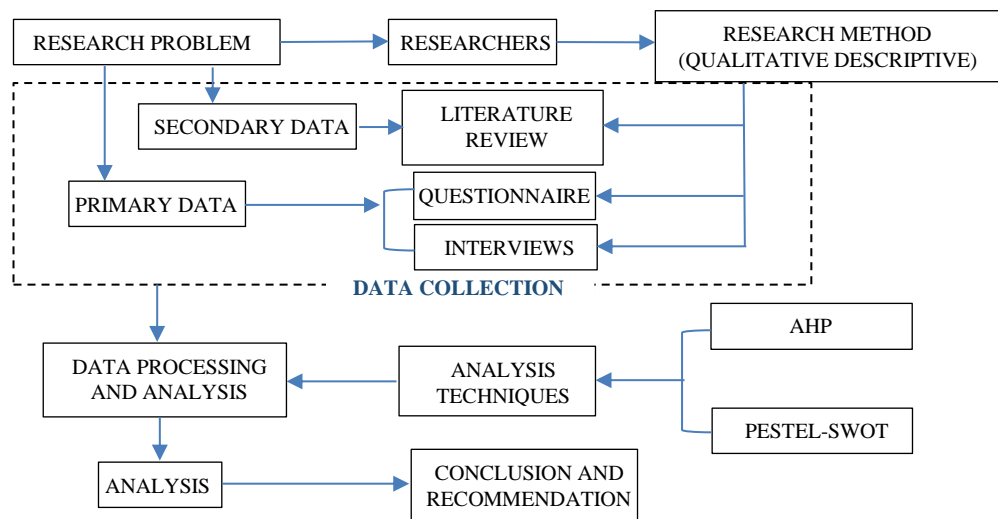


Figure 1. Research Design

3.1. AHP

AHP is a multi-criteria decision-making methodology that structures several criteria and alternatives on an object of study in a hierarchical arrangement to allow structured decision-making using a pairwise comparison matrix for assessing the priority of the criteria and the desired alternative against the weighting of the criteria [12] [13] [14]. AHP is useful for assisting decision-makers in solving problems that have several subjective criteria by dividing the complex problem into simpler sub-problems and then combining the solutions in all sub-problems into solutions [15]. In this study, AHP was carried out based on the adaptation of the Saaty's AHP procedure through the following steps:

- a. Determining the objectives, criteria, sub-criteria and decision-making alternatives to serve the objective.
- b. Developing a hierarchical structure, which consists of the final decision-making objective, criteria, sub-criteria, and alternatives.
- c. Preparing pairwise comparison matrices between criteria, sub-criteria, and alternatives.
- d. Entering the relative importance weights between each criterion, sub-criteria, and alternatives based on decision-makers' preferences using values based on the scale shown in Table 1.

Table 1. Relative Level of Importance Scale

Relative Level of Importance	Definition
1	Both elements are equally important
3	One element is slightly more important than the other
5	One element is more important than the other
7	One element is certainly more important than the other
9	One element is absolutely more important than the other
2, 4, 6, 8	Intermediate values between two adjacent preferences

- e. Normalizing the data by dividing the value of each cell by the total number of columns in which each cell is positioned.
- f. Calculating the geometric mean of each row in the matrix to determine the weight or rank between criteria, sub-criteria, and alternatives in making decisions.
- g. Perform data consistency testing by dividing the consistency index with the random consistency index value. If the consistency ratio is more than 0.1, steps d to g must be repeated. The formula for calculating the consistency ratio is shown as follows.

$$CI = \frac{\lambda_{\max} - n}{n}$$

$$CR = \frac{CI}{RI}$$

Where:

CI : Consistency index

n : number of elements

RI : random consistency index, which value is shown in Table 2

Table 2. Random Consistency Index Value

<i>n</i>	3	4	5	6	7	8	9	10	11	12
<i>RI</i>	0.58	0.9	1.12	1.24	1.32	1.41	1.49	1.51	1.53	1.56

Source: Saaty (1990)

3.2. PESTEL

PESTEL is a mnemonic expression, namely P for Political, E for Economic, S for Social, T for Technological, L for Legal, and E for Environmental, which is used as a tool by companies or other entities to provide a big picture for analyzing the environment or context in which they operate in order to review or implement an idea or plan [16]. The concept of PESTEL analysis is originated from the PEST analysis, which was coined by Francis Aguilar in 1967, as a framework for planning and strategic analysis in the study of the micro-environment and macro-environment, as well as for developing strategic thinking [17]. The advantages of PESTEL are that it is simple and easy to understand and use, helps to understand the environment better, encourages the development of strategic thinking, and helps reducing the effects of future

threats [16]. PESTEL analysis can help organizations to anticipate difficulties that may be encountered in the future and take action to avoid or minimize their effects.

In this study, PESTEL analysis is used to produce a descriptive analysis of the context and various factors that need to be considered in making strategic decisions on the acquisition of military amphibious aircraft. Data validity for PESTEL analysis is tested by employing data source triangulation from several informants and secondary literatures.

3.3. SWOT

SWOT is a mnemonic expression, namely S for Strength, W for Weakness, O for Opportunity, and T for Threat [18]. SWOT analysis is a tool for strategic planning and strategic management [19]. In the systems paradigm, defense sector can be seen as a whole sum of its subsystems that interact with their environment [13]. In this sense, an organization exists in two environments, namely within itself (internal) and beyond itself (external).

SWOT analysis has two dimensions, namely internal and external. Strengths and weaknesses are the internal dimensions, while opportunities and threats are the external dimensions [18]. SWOT analysis is usually made in a box with four quadrants based on the Strength, Weakness, Opportunity, and Threat categories. Strengths and Opportunities are very helpful or beneficial in achieving organizational goals, while Weaknesses and Threats are harmful to the achievement of organizational goals. Analysis of Strengths and Weaknesses based on internal organizational factors and the analysis of Opportunities and Threats based on the external environment are imperative for the success of every strategic decision that an organization makes.

In this study, SWOT analysis was carried out by mapping the themes that emerged from the results of the PESTEL analysis into SWOT elements according to the nature and implications of each PESTEL theme on military amphibious airplane acquisition decision making, whether they are strengths, weaknesses, opportunities, or threats. Thus, the application of PESTEL-SWOT analysis in this study can produce a structured and comprehensive analysis that is easy to be understood by policymakers for organizing and comprehending the context of military amphibious aircraft acquisition decision-making in order to enrich the results AHP and PESTEL analysis as well as to prescribe the required strategy to prepare for the acquisition.

4. Result and Discussion

4.1. Military Amphibious Aircraft Acquisition Decision-Making based on AHP Result

AHP application for the acquisition of military amphibious aircraft decision-making in this study employed three main criteria, namely capability, maintenance, and cost. Capability criteria is the type and level of capability possessed by military amphibious aircraft to support various national defense missions. Maintenance criteria are related to the maintenance aspects of military amphibious aircraft to carry out their functions reliably. Cost criteria include all required costs to acquire, operate and maintain military amphibious aircraft.

To assess alternatives in more detail, the capability criteria are specified into 7 sub-criteria, namely maritime patrol, search and rescue, personnel and logistics transport, medical evacuation, aerial photography and survey, water bombing, and payload capability. Meanwhile, the maintenance aspect is broken down into 4 sub-criteria, namely human resources capacity, spare parts availability, maintenance facilities/depots capacity, and the availability of aircraft maintenance service providers. Finally, the cost aspect is divided into 3 sub-criteria, namely acquisition cost, operational cost, and maintenance cost.

This study uses Shinmaywa US-2 from Japan, Bombardier CL-415 from Canada, and Beriev

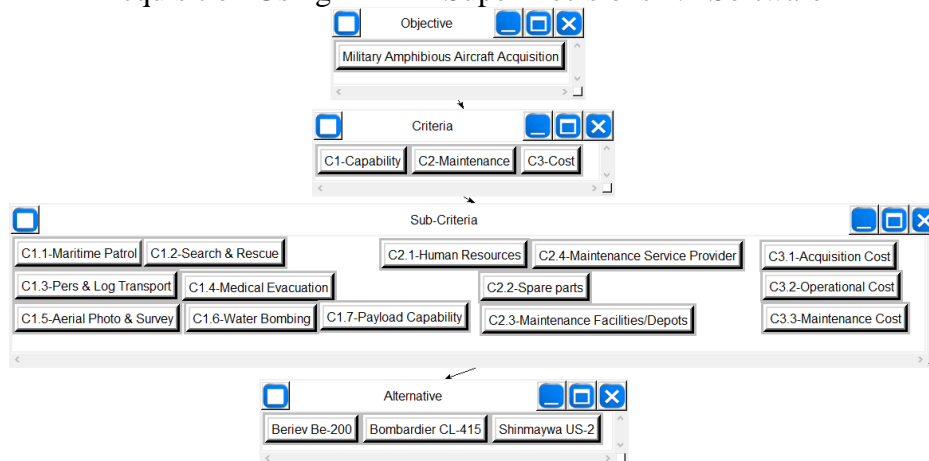
Be-200 from Russia as the aircraft alternatives. A general comparison of three aircraft models' technical specifications is shown in Table 3. The AHP hierarchical structure in this study is shown in Figure 2.

Table 3. General Technical Specifications Comparison of the Three Aircraft Alternatives

Aspect	ShinMaywa US-2	Beriev Be-200	Bombardier CL-415
Manufacturer's Country of Origin	Japan	Russia	Canada
Engine	Four-turboprop	Twin-turboprop	Twin-turbofan
Length	33,3 m	19,8 m	31,4 m
Max Take-off Weight	47,7 ton	19,9 ton	41 ton
Range	> 4.700 km	2.426 km	3.300 km
Cruise Altitude	> 9.000 m	3.048 m	7.896 m
Cruise Speed	480 km/h	278 km/h	560 km/h
Take-off Distance	280 m	808 m	1000 m
Landing Distance	330 m	665 m	1.300 m
Wave Height	up to 3 m	up to 1,8 m	up to 1,2 m

Source: Taylor (1993)

Figure 2. Hierarchical Structure of Decision Making for Military Amphibious Aircraft Acquisition Using AHP in Super Decisions 2.1 Software



Afterward, the normal geometric mean value was calculated using the normalized values in each criterion, sub-criteria, and alternative, which were ranked to show the respondents' preferences for each criterion, sub-criteria, and alternative as shown in Table 4, Table 5, Table 6, Table 7, and Table 8. The last step was calculating the weighted value by multiplying the value of each alternative, sub-criteria, and criteria to obtain the final result for the most preferred aircraft, as shown in the "Weighted Aggregate Value" column in Table 8. Based on the result, Beriev Be-200 is the most preferred military amphibious aircraft model to be acquired for supporting Indonesia's defense missions, with a weighted aggregated score of 0.087602909. Capability is the most important criteria, and maritime patrol is the most important sub-criteria

within the capability criteria in deciding the most preferred military amphibious aircraft for acquisition. The AHP results are reliable as shown in the consistency ratio of all pairwise comparison results which fall below the threshold of 0.1.

Table 4. Ranking Comparison Results between Criteria for Military Amphibious Aircraft Acquisition Decision-Making

Criteria	Normalized Geometric mean	Rank
Capability	0.685930438	1
Maintenance	0.220452544	2
Cost	0.093617018	3
Consistency Ratio:		0.03442

Table 5. Ranking Comparison Results between Capability Sub-Criteria for Military Amphibious Aircraft Acquisition Decision-Making

Sub-Criteria	Normalized Geometric mean	Rank
Maritime Patrol	0.390328689	1
Search and Rescue	0.231417549	2
Personnel and Logistics Transport	0.158309908	3
Medical Evacuation	0.089681907	4
Aerial Photography and Survey	0.067567918	5
Water Bombing	0.037926829	6
Payload Capability	0.0247672	7
Consistency Ratio:		0.06213

Table 6. Ranking Comparison Results between Maintenance Sub-Criteria for Military Amphibious Aircraft Acquisition Decision-Making

Sub-Criteria	Normalized Geometric mean	Rank
Human Resources	0.536238531	1
Spare parts	0.274207799	2
Maintenance Facilities/Depots	0.123510047	3
Aircraft Maintenance Service Providers	0.066043623	4
Consistency Ratio:		0.032178571

Table 7. Ranking Comparison Results between Cost Sub-Criteria for Military Amphibious Aircraft Acquisition Decision-Making

Sub-Criteria	Normalized Geometric mean	Rank
Acquisition Cost	0.085437161	1
Operational Cost	0.634631445	2
Maintenance Cost	0.279931394	3
Consistency Ratio: 0.028031429		

Table 8. Aggregated Ranking Comparison Results between Alternatives and Criteria for Military Amphibious Aircraft Acquisition Decision-Making

Aircraft Model Alternative	Sub-Criteria within Capability Criteria	Sub-Criteria within Maintenance Criteria	Sub-Criteria within Cost Criteria	Weighted Aggregate Value	Ranking
Beriev Be-200	0.598552525	0.291546889	0.222225185	0.087602909	1
Shinmaywa US-2	0.241102313	0.094474088	0.130291616	0.063903347	2
Bombardier CL-415	0.160345162	0.612932299	0.647483199	0.032739342	3
Consistency Ratio:	0.041682449	0.043643214	0.042770476		

4.2. Context Analysis and Strategy Formulation of Military Amphibious Aircraft Acquisition using PESTEL-SWOT

The summary of PESTEL-SWOT analysis in this study is shown in Figure 3. Based on the results of the PESTEL-SWOT analysis, four Strengths were identified, where each one is located in the Political, Social, Technological, and Legal dimensions; two Weaknesses, where each one is located in the Economic and Technological dimensions; three Opportunities, where each one is located in the Political, Environmental, and Legal dimensions; and one Threat in the Technological aspect. Strengths are the internal factors that supported the acquisition of military amphibious aircraft, while Weaknesses are the internal factors that hindered the acquisition of military amphibious aircraft. The identified opportunities are external factors that have the potential to benefit from the decision to acquire military amphibious aircraft, while the identified threat indicates the potential future problems which stemmed from the decision to acquire military amphibious aircraft.

Figure 3. Summary of PESTEL-SWOT Analysis on Military Amphibious Aircraft Acquisition Decision-Making in Indonesia's Context

	STRENGTH	WEAKNESS	OPPORTUNITY	THREAT
POLITICAL	Good diplomatic relations with the manufacturer's country of origin. Russia never intervene domestic affairs of the buyer country	N/A	The acquisition program opens opportunity to strengthen defense cooperation with the manufacturer's country of origin	N/A
ECONOMIC	As Beriev's country of origin, Russia has state credit facility with low interest rate for defense export	Limited state fiscal capability	N/A	N/A
SOCIAL	Past experiences of leasing Beriev Be-200 aircraft to combat forest fire	N/A	N/A	N/A
TECHNOLOGICAL	The Indonesian Armed Forces is used to operate and perform maintenance of turboprop-engine aircrafts. Beriev Be-200's capability can be upgraded to become anti-submarine aircraft	Limited capacity of the Indonesian Armed Forces' maintenance facilities and depots, as well as domestic aircraft maintenance service providers	N/A	The risk of spare parts scarcity due to high dependence from foreign supply
ENVIRONMENTAL	N/A	N/A	The ownership of military amphibious aircraft will improve Indonesia's defense sector capabilities to carry out various missions, as well as improving national connectivity to remote areas, especially the outermost islands	N/A
LEGAL	Indonesia has ratified bilateral agreements with Russia and Japan related to defense industry and technology cooperation. As Beriev's country of origin, Russia never impose any sanctions to buyer country	N/A	The acquisition program opens opportunity for Indonesia to implement Law No. 16/2012 on Defense Industry to improve national defense industries' capacity related to military amphibious aircraft technology	N/A

The identified Strengths, Weaknesses, Opportunities, and Threats are explained as follows:

a. Strengths:

- 1) Political: Countries of origin of the three aircraft models' manufacturers, namely Canada, Russia, and Japan, have good diplomatic relations with Indonesia. This factor is an advantage for Indonesia shall it acquire one of the three amphibious aircraft models, because Indonesia will not face huge political obstacles from the government of the country of origin of the aircraft manufacturer in acquiring one of the selected military amphibious aircraft model. In the case of Rusia as the Beriev Be-200 aircraft manufacturer (the most preferred aircraft based on AHP result), it never imposed any terms that intervene the buyer country's domestic affairs in the acquisition contract.
- 2) Economic: Shall Indonesia acquire Beriev Be-200 aircraft, Rusia as the manufacturer's country of origin could provide state credit facility with low interest rate for the buyer country.
- 3) Social: Users in the Indonesian Navy and Indonesian Air Force are welcoming the plan to acquire military amphibious aircraft, given its multirole capabilities that can be used to support various national defense missions more effectively. In particular, the Indonesian government has leased Beriev Be-200 aircraft several times to fight forest fires. Thus, the Indonesian Armed Forces is already familiar with the aircraft's

characteristics shall it be acquired in the future. Beriev Be-200 aircraft were leased in 2015 to fight forest fires in Sumatra, and in 1997 to fight forest fires in the remote areas in East Kalimantan, Indonesia [5]. These experiences have made various stakeholders in the defense sector and other related public sectors believe that amphibious aircraft is a necessary platform to be acquired by Indonesia.

- 4) **Technological:** Two of the three types of amphibious aircraft are turboprop engine aircraft, while the other one is a turbofan engine aircraft. The Indonesian Armed Forces have several aircraft models with these types of engines, so the personnel will be relatively easy to adapt in operating and carrying out the routine and small maintenance of the three military amphibious aircraft models with turboprop and turbofan engines. The personnel may only need to learn to be able to fly and land amphibious aircraft in the water using a slightly different method from ordinary aircraft, as well as on the maintenance of the aircraft frame. In the case of Beriev Be-200, it can also be upgraded to become an anti-submarine aircraft for supporting Indonesia's defense capability for anti-submarine warfare. This capability is also important for Indonesia amid the current strategic environment development, where many countries in the region and outside the region operate submarines in the Indo-Pacific body of waters.
 - 5) **Legal:** Indonesia already has defense cooperation agreements with Russia and Japan, which will support the decision shall Indonesia acquire military amphibious aircraft from one of the countries. Indonesia has a bilateral defense cooperation agreement with Russia that was ratified on 18 May 2016, which was promulgated in 2019 in the Law of Republic of Indonesia Number 7 of 2019 on the Ratification of Agreements between the Government of the Republic of Indonesia and the Government of the Russian Federation on Cooperation in the Defense Sector [20]. Meanwhile, on March 31, 2021, Indonesia has just signed a cooperation agreement on the Transfer of Defense Equipment and Technology with Japan [21]. One scope of the agreement between both countries is cooperation in the development of defense science and technology and the defense industry. Furthermore, both countries never impose any sanctions on defense acquisition to the buyer country.
- b. **Weaknesses**
- 1) **Economic:** From the economic aspect, Indonesia is constrained by its limited fiscal capacity to acquire military amphibious aircraft. The budget for the main weapons system and equipment modernization of the Indonesian Navy and Indonesian Air Force is approximately 40 trillion rupiahs (around USD 3 billion) for each service during the 5-year period strategic. This sum of budget is still has to be allocated for various other modernization program priorities, which left small fiscal space for the acquisition of military amphibious aircraft. Meanwhile, the acquisition cost per unit is quite expensive, where according to several informants the cost for acquiring the Bombardier CL-415 model is around USD 37 million, the Beriev Be-200 model is around USD 70 million, and the Shinmaywa US-2 is around USD 113 million. In terms of operations and maintenance, military amphibious aircraft also requires expensive cost to operate and maintain. The estimation of annual operational costs according to the informants ranged from USD 500 thousand to 1 million, while the estimated annual maintenance costs ranged from USD 1 million to 2 million. In addition, the national economic condition and the state's fiscal capacity that currently still undergo recovery phases due to the COVID-19 pandemic, also

necessitate Indonesia to save its budget for its highest priority spending. This, it is still unable to acquire military amphibious aircraft despite the importance to support various national defense missions.

- 2) Technological: In the aircraft maintenance aspect, the Indonesian Armed Forces is faced with the limited capacity of its aircraft maintenance facilities/depots. Indonesia also has a small number of domestic companies that provide aircraft maintenance services. Thus, medium and heavy maintenance, repair, and overhaul activities of the aircraft will likely depend a lot on foreign aircraft maintenance service providers, which will require a relatively longer process and more expensive cost compared to the domestic one.

c. Opportunities

- 1) Political: The plan to acquire military amphibious aircraft can be an opportunity to strengthen the existing defense cooperation between Indonesia and one of the countries of origin of the aircraft manufacturer, whether Russia, Japan, or Canada. Good diplomatic relations and cooperation that has been established between these countries are the basic capital for Indonesia to be able to learn and master amphibious aircraft technology in the future. Thus, there will be an opportunity in the future for Indonesia to be able to produce some or the whole parts of military amphibious aircraft.
- 2) Environmental: The acquisition of military amphibious aircraft opens up opportunities for the Indonesian Armed Forces to optimize its main duties given its geographical characteristics and threats. Border areas have become an important nexus for many transnational threats and violations of territorial sovereignty by state actors and non-state actors. Amphibious aircraft can assist to conduct border patrols and law enforcement against violations of territorial sovereignty. The ability of amphibious aircraft to take off and land in water will also assist the Indonesian Armed Forces in carrying out its main duties in areas that are lack connectivity infrastructure and difficult to reach using other military transportation modes, such as the outermost islands. Military amphibious aircraft will also be able to support SAR missions and distribute logistics to the outermost islands in supporting national development programs. Thus, amphibious aircraft will be a solution to deal with the increasing demand of inter-island transportation and logistics distribution in the face connectivity infrastructure issue in Indonesia.
- 3) Legal: Bilateral cooperation agreements in defense sector between Indonesia and Russia as well as between Indonesia and Japan, where one of the scopes is cooperation in the development of defense science and technology as well as the defense industry, can be an opportunity for Indonesia to increase the capacity of the domestic defense industry through provisions of offset, local content, and/or transfer of technology as mandated in the Law of the Republic of Indonesia Number 16 of 2012 on Defense Industry. Thus, the plan to acquire military amphibious aircraft will open up opportunities for capacity building and empowerment of the domestic defense industry, both State-Owned Enterprises and Private-Owned Enterprises, in military amphibious aircraft design, components production, assembly, and maintenance.

- d. Threat: In the technological dimension, there is a risk of spare parts scarcity that Indonesia has to address shall it owns military amphibious aircrafts. This risk is mainly caused by Indonesia's high dependence on foreign spare parts supply. This risk can be

reduced by increasing the capacity of the domestic industry to produce and supply amphibious aircrafts' spare parts. If not, aircrafts that Indonesia will own might be incapable or fail to operate optimally, which will render it useless, shall spare parts scarcity risk materializes in the future.

Based on the weaknesses and threats found from the PESTEL-SWOT analysis, Indonesia is still experiencing several obstacles shall it decide to acquire military amphibious aircraft, namely the limited defense budget amid various other defense equipment modernization priorities, the limited capacity of Indonesian Armed Forces' aircraft maintenance facilities/depots to carry out aircraft maintenance optimally, and the limited numbers of domestic aircraft maintenance service providers. Indonesia is also potentially vulnerable to the risk of spare parts scarcity that may occur in the future if it acquires military amphibious aircraft, because currently it still heavily relies on foreign spare parts supply. To address the aforementioned weaknesses and threats, Indonesia must seek to increase its fiscal capacity for its defense sector development and build a strong aircraft maintenance ecosystem, so it will be able to own and maintain military amphibious aircraft independently in the future.

5. Conclusion

This study has successfully applied a combination of several strategic decision-making methods, namely AHP and PESTEL-SWOT, to produce useful results as a scientific recommendation and reference on military amphibious aircraft acquisition decision-making for defense sector policymakers in Indonesia. The AHP results showed that Beriev Be-200 is the most preferred military amphibious aircraft model alternative by users in military aviation background, while capability is the highest priority criterion in military amphibious aircraft acquisition decision-making consideration and maritime patrol capability as a sub-criteria which ranks top in the capability criteria.

Based on the PESTEL-SWOT analysis results, it can be concluded that the strengths of acquiring Beriev Be-200 are the good diplomatic relations Indonesia has with Russia as the manufacturer's country of origin that never intervenes the buyer country's domestic affairs; the available state credit facility with low interest for defense acquisition from Russia; supportive social conditions of the users on military amphibious aircraft acquisition; the pilot and technical personnel's ability to adapt quickly in operating and maintaining the aircraft; the possibility of upgrading the aircraft capability to become anti-submarine aircraft; the existing cooperation between Indonesia-Russia related to defense technology; the absence of sanctions on defense acquisition from Russia; and the Indonesian Armed Forces' familiarity with Beriev Be-200 model that has been leased several times by Indonesia to fight forest fires in several areas. The acquisition of military amphibious aircraft also has the potential to open up opportunities for Indonesia to further enhance defense cooperation and good diplomatic relations with the country of origin of the aircraft manufacturers; enable the Indonesian Armed Forces to optimize its duties; improve connectivity to remote areas in Indonesia, especially the outermost islands; and increasing the capacity and empowerment of the domestic defense industry in realizing Indonesia's defense independence.

The weaknesses lie in the several obstacles and considerations that hinder Indonesia from acquiring military amphibious aircraft, namely the limited defense budget for weapons systems and equipment modernization; the limited capacity of the Indonesian Armed Forces' aircraft maintenance facilities/depots to carry out amphibious aircraft maintenance optimally; and the limited numbers of domestic aircraft maintenance service providers in Indonesia. The threat to the aircraft acquisition lies in Indonesia's vulnerability to the risk of spare parts scarcity if it

acquires military amphibious aircraft, because it still relies heavily on spare parts supply from foreign suppliers. As the prescribed strategic recommendation to address the aforementioned weaknesses and threat, Indonesia must seek to increase its fiscal capacity for the defense sector development and strengthen its domestic aircraft maintenance ecosystem, especially domestic spare parts producers and maintenance service providers, to be able to perform maintenance of military amphibious aircraft independently in the future.

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