



## Jurnal Pertahanan

Media Informasi tentang Kajian dan Strategi Pertahanan  
yang Mengedepankan *Identity, Nationalism* dan *Integrity*

e-ISSN: 2549-9459

<http://jurnal.idu.ac.id/index.php/DefenseJournal>



### COST-BENEFIT ANALYSIS OF THE PT. PAL'S SUBMARINE PROJECT DEVELOPMENT IN REALIZING DEFENSE INDUSTRY INDEPENDENCE

Arif Sutansyah Tambunan<sup>1</sup>, Rudi Lazuardi<sup>2</sup>, Elisabeth Tanti Pudiastuti<sup>3</sup>

Naval Staff and Command College

Ciledug Raya Street No. 2, South Jakarta, DKI Jakarta, Indonesia 12230

[arif.s.tambunan@gmail.com](mailto:arif.s.tambunan@gmail.com)<sup>1</sup>, [rudi.lazuardi@gmail.com](mailto:rudi.lazuardi@gmail.com)<sup>2</sup>, [elisabeth.tanti@gmail.com](mailto:elisabeth.tanti@gmail.com)<sup>3</sup>

#### Article Info

##### Article history:

Received : May 24, 2022

Revised : August 29, 2022

Accepted : August 30, 2022

##### Keywords:

AHP,

Cost-Benefit,

Defense Industry

PT. PAL

Submarine

#### Abstract

Based on Law no. 16 of 2012 and the Decree of the Indonesian Defense Industry Policy Committee, PT. PAL is the lead integrator of the Main Tool of the Navy Weapon System. After the manufacture of 2 (two) submarine units, which are Ardedali-404 and Alugoro-405, at the PT. PAL in collaboration with the South Korean Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME) company, planned to build the 4th to 12th new submarine units that will be implemented starting in 2021 until 2042. The purpose of this study was to identify and determine the result of the Benefit-Cost Analysis in considering the submarine project's positive effect on PT. PAL is the independent defense industry. The method used is a qualitative method supported by Analytical Hierarchical Process (AHP) tools and Benefit-Cost Ratio (BCR) theory to analyze the result. Based on the results showed that the weight of the highest benefit criteria is B-2 (Independence of PT. PAL as a defense industry) which indicates that the point of realizing independence in Indonesia's Defense Industry can be considered as the main important aspect as it may be followed by the other progress or development to support national defense in Indonesia. Then, the weight of the highest cost criteria is C-1 (Transfer of Technology (ToT) is not fully implemented) which means the cost that is need to be considered in realizing the independence of PT. PAL as the defense industry is not fully implemented in Indonesia. Finally, the chosen alternative is A-1, which is to continue cooperation in the construction of the Submarine Project that would be better if it is supported by the commitment of the company and government, especially in facing the cost of reaching the benefit as described before. So, the policy that needs to be taken is to continue the next submarine-building project.

DOI:

<http://dx.doi.org/10.33172/jp.v8i2.1701>

© 2022 Published by Indonesia Defense University

## INTRODUCTION

Based on the United Nations Convention on the Law of the Sea (UNCLOS) that Indonesia is the largest archipelagic country in the world with an ocean area of 5.9 million km<sup>2</sup>, which consists of territorial waters, inland waters, and archipelagic waters as well as the Exclusive Economic Zone (EEZ) with 81,000 km long coastline, and approximately 17,506 islands (Defender, 2015). As a consequence of an archipelagic country that is rich in natural resources, the potential for crimes that arise from the sea will become real. This is marked by an increase in illegal activities using maritime media. Exploitation and illegal activities of maritime resources are carried out by local and transnational actors. Other problems are maritime border delimitation, quantity, and quality of maritime human resources, weak law enforcement, and limited maritime infrastructure add to the list of maritime problems in Indonesia (Hidayat & Ridwan, 2017).

Periska, Siahaan, & Aritonang (2020) stressed that in the context of national defense and maintaining sovereignty, there is a lot of equipment needed to support the national defense made by the defense industry in Indonesia. The Secretary General of the Ministry of Defense of Indonesia stated that the independence of the defense industry is something very important in maintaining the defense system of a strong, developed, and independent country. The strong industry is expected to be able to provide a good multiplier effect to economic development and control technology for the Indonesian people. The independence of the defense industry is also expected to realize the shift in understanding away from defense spending becoming a defense investment as directed by the President of Indonesia (WIRA: Media Informasi Kementerian Pertahanan, 2020).

Wibowo (2016) added that the efforts in realizing defense industry independence

cannot be separated from the concept of three pillars of industry players in the concept of defense and industrial cluster. The concept of the three pillars of defense industry actors refers to the integrated relationship between Universities or College Research Community and Development (R&D) as science and defense technology developers, private or industry sector as the utilizer of production and distribution from the results of defense science and technology, and Indonesia Armed Forces as the user. This is also supported by Efendie, Kiswara, & Purboyo (2022) who stated that in the context of the independent defense industry, academics/scholars include researchers, educators or study groups, and other figures in the field of science related to the development of defense industry. Academics/scholars are the main actors driving the birth of creativity, ideas, knowledge, and technology for the growth of independence in the defense industrial sector.

The defense industry is one of the vital components of defense capability. A strong defense industry has two main effects, namely the direct effect on the development of defense capabilities, and the national economic and technological development. In the field of defense capability building, a strong defense industry guarantees the supply of the need for armaments and means of defense on an ongoing basis. The availability of a continuous supply of the main weapon system (defense equipment) is a prerequisite to absolute freedom and certainty to formulate development plans for defense capability in the long term (Susdarwono, 2020).

Indonesia should have a national defense view as a maritime nation. However, in securing and protecting the vast territorial waters, the Indonesian Navy is only reinforced with 144 warships, of which only 75% are capable of operating, most of which are old. According to the Commander of the Indonesian National

Army, in the current condition, it is estimated that the achievement of the Indonesian Navy's Minimum Essential Forces (MEF) until 2022 will only reach 59.9% (Fajarta, 2022).

To fulfill the 3<sup>rd</sup> stage of Minimum Essential Forces (MEF) 2020-2024, the Indonesian Navy has taken accelerated steps by collaborating with PT. PAL is one of the defense industries in the manufacture of several ships on the water including submarines. Two submarines were recorded as the result of PT. PAL's manufacture, although the construction was not entirely the work of PT. PAL but the result of collaboration with Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME) South Korea (PT. PAL Indonesia, 2019). The following is a list of submarines made by PT. PAL in collaboration with South Korea.

**Table 1.** The Submarine lists produced by PT. PAL

No	Name	Ordering Country	Manufacturing countries
1	KRI Ardedali-404	Indonesia	Indonesia and South Korea
2.	KRI Alugoro-405	Indonesia	Indonesia and South Korea

*Sources:* PT. PAL Indonesia, n.d.

Based on Law No. 16 of 2012 and the Decision of the Indonesian Defense Industry Policy Committee, PT. PAL is the lead integrator of the Navy Main Weapon System. Through long-term and short-term plans, the company has carried out business repositioning that focuses on defense equipment products with the support of General Engineering and Maintenance businesses as a source of fast cash for the company. Industry progress rate of PT. PAL can be used as a benchmark for the progress of science and technology that has been mastered and applied by Indonesians in the field of marine/shipping technology. However, PT. PAL is only able to a limited extent in the field of shipbuilding, while in the field of maintenance is approaching the

capabilities of countries that have more advanced (Antoni, 2022).

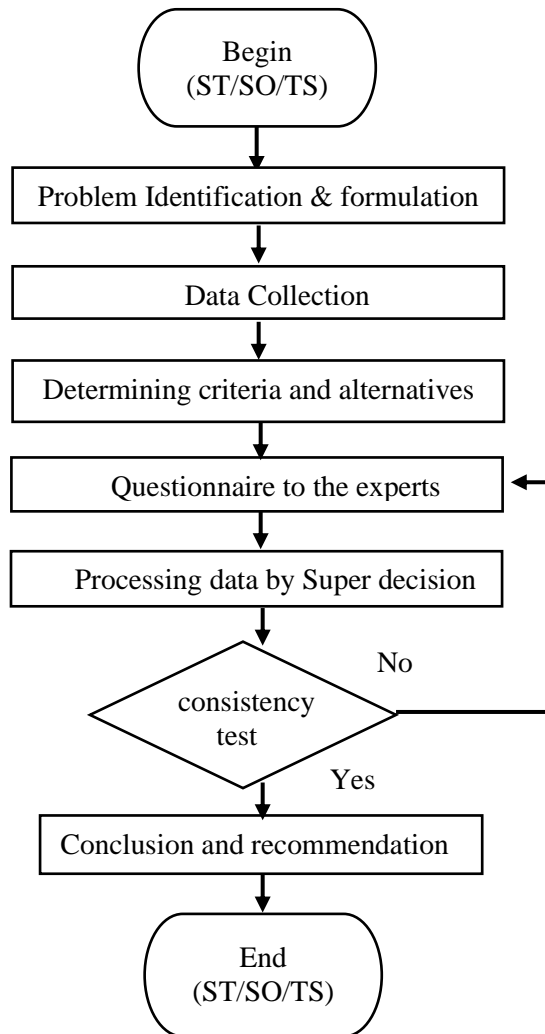
After the construction of the 3<sup>rd</sup> submarine, it is planned that the construction of a new submarine, 4<sup>th</sup> submarine to 12<sup>th</sup> submarine, will be carried out from 2021 to 2042, and maintenance, repair & overhaul (MRO) activities for submarines (Indonesian Warship Nanggala (KRI Nanggala) and 1<sup>st</sup> to 12<sup>th</sup> submarines projects from 2022-2063) with a projected profit in the submarine construction business of IDR 4,209.84 billion (48.28%) and the Submarine MRO business contributing IDR 4,509.33 billion (51.72%). In addition, it will benefit from mastering the technology for building and maintaining submarines with high technical characteristics, which will provide benefits not only in the short term but also in the long term in the form of intangible assets (Dewan Perwakilan Rakyat Republik Indonesia, 2021).

However, the need to consider the beneficial aspects in realizing the idea to manufacture the submarines is crucial. The result of this study is expected to answer the gap of the study, which is how to determine the continuation of submarine manufacture by PT. PAL is facing the cost available to do it. Based on the description above, the object of the study is Benefit Cost-Analysis for the PT. PAL'S submarine project development to determine the importance of this project to support the realization of PT. PAL industry is an independent defense industry in Indonesia. The study aims to identify and determine the result of the Benefit-Cost Analysis in considering the submarine project's positive effect on PT. PAL is the independent defense industry.

## METHODS

The method used in this research was the qualitative method. Creswell (2010) stated that the qualitative method is one of the ways in exploring means of facing certain problems. The locus of the study was conducted at PT. PAL Surabaya in April

2022. The informants are from several roles and person in charge of the submarine division of PT. PAL. This research was conducted in four stages, namely the preliminary stage, data collection, data processing, and analysis and the last stage is the conclusion and suggestion stage. As shown in the flow chart in Figure 1.



**Figure 1.** Flow Diagram of Research Method  
*Source:* Adopted from Dwiyanto (2006)

The preliminary stage consists of problem identification and goal setting. The data collection stage was carried out through interviews and literature studies to find benefit and cost factors. At the data processing stage, pairwise comparison was carried out using the Analytical Hierarchical Process (AHP). After obtaining the weight of the benefit and cost criteria, test the consistency. At the data

analysis stage, an analysis of these calculations is carried out which will later be used as a reference in concluding. At the conclusion stage, conclusions are drawn from the calculations that have been made and suggestions are made to support the conclusions that have been drawn. AHP is a decision support method developed by Thomas L. Saaty. This decision support model will describe a complex multi-factor or multi-criteria problem into a hierarchy. Hierarchy is defined as a representation of a complex problem in a multilevel structure where the first level is the goal, followed by the level of factors, criteria, sub-criteria, and so on until the last level of alternatives (Saaty, 1980). Moreover, the use of Benefit Cost Ratio (BCR) Theory According to Rinaldi (2013) BCR analysis is an analytical approach with a systematic procedure to compare a series of relevant costs and benefits, with an activity or project. The final goal of this analysis is to compare the two values between benefits and costs, which one is greater.

AHP is used as a problem-solving method and then later described qualitatively, compared to other methods for the following reasons:

1. Hierarchical structure, as a consequence of the selected criteria, to the deepest sub-criteria.
2. Calculating the validity up to the inconsistency tolerance limit as the criteria and alternatives chosen by the decision maker.
3. Calculating the durability of the decision-making sensitivity analysis output.

The steps taken in the AHP method are as follows:

1. Define the problem and determine the desired solution.
2. Creating a hierarchical structure that starts with the main goal.
3. Defining pairwise comparisons so that the total number of raters is determined. Comparative assessment data collection can be obtained using a questionnaire or

conducting individual comparison assessments with predetermined considerations. For more details regarding the comparison assessment preference table, it is shown in the Table 2.

4. Creating a pairwise comparison matrix that describes the relative contribution or influence of each element on the goals or criteria at the level above it.
5. Calculating the eigenvalues or normalization and testing its consistency. If it is not consistent then the data collection must be repeated.
6. Repeating steps 3, 4, and 5 for all levels of the hierarchy.
7. Calculating the eigenvectors of each pairwise comparison matrix which is the weight of each element for determining the priority of the elements at the lowest hierarchical level until reaching the goal.

**Table 2.** AHP Pairwise Comparison Rating Scale

Intensity of Interest	Explanation
1	Both elements are important
3	One element is slightly more important than the others
5	One element is more important than the others
7	One element is more absolutely important than the others
9	One element is absolutely important than the others
2,4,6,8	The values between the two values of adjacent considerations

Source: Saaty, 1980

## RESULTS AND DISCUSSION

PT. PAL is one of the strategic industries that produce the main tools of the Indonesian defense system, especially for the Indonesian Navy. Its existence certainly has an important and strategic role in supporting the development of the National marine industry. The role of PT. PAL is getting stronger after the issuance of Law no. 16 of 2012 concerning the

defense industry in which strategic State-Owned Enterprises are given a wider space. Based on the law, PT. PAL Indonesia professionally carries out the mandate as well as the obligation to play an active role in supporting the fulfillment of the needs of the marine defense equipment and acts as a lead integrator for the marine dimension. PT. PAL Indonesia is located in Ujung, Surabaya, with its main business activities including:

1. Manufacture of warships and merchant ships.
2. Providing ship repair and maintenance services.
3. Providing general engineering with specific specifications based on the client's requirements.

In shipbuilding, PT. PAL has 5 (five) divisions, one of which is the Submarine Division which has the following main tasks:

1. Carry out planning and construction of submarines and non-submarine ships according to the policy of the Director of shipbuilding.
2. Detailing the Project Implementation Instructions (IPP) that have been prepared by the Directorate of ship development into a detailed project implementation schedule and project cost value.
3. Implement shipbuilding effectively and efficiently according to Quality, Cost, and Delivery (QCD) aspects.
4. Controlling and supervising the implementation of project development to obtain satisfactory results.

### Determining Benefit Criteria

Based on brainstorming with experts in the field from the submarine division of PT. PAL, the following benefit criteria were obtained:

1. PT. PAL's HR capabilities are increasing. One thing that has a positive impact or benefits with the government program is the manufacture of submarines carried out by PT. PAL in collaboration with Daewoo Shipbuilding & Marine Engineering

- Co., Ltd (DSME) South Korea is the increase in the ability of PT. PAL's employees, especially the submarine division, involving employees to participate in training and be directly involved in the manufacture of submarines will give confidence in the abilities and capabilities of individuals so that in the aspect of human resource capabilities, this collaboration is very beneficial for PT. PAL, especially the submarine division.
2. The independence of PT. PAL as one of the defense industries. The success of PT. PAL in completing the Alugoro and Ardedali submarine construction project which was handed over to the Indonesian Navy was able to reflect the independence of PT. PAL is one of the defense industries. This is in line with the government's vision and mission in developing and strengthening the defense industry sector to support Indonesia's Integrated Fleet Weapon System.
  3. The capability and existence of PT. PAL is recognized by the maritime world. The submarine project is a new thing for PT. PAL, especially the submarine division, so it requires careful planning so that the Transfer of Technology (ToT) process and implementation can be carried out properly. The role of PT. PAL Indonesia is getting stronger after the issuance of Law no. 16 of 2012 concerning the defense industry in which strategic State-Owned Enterprises (BUMN) are given a wider space. Based on the law, PT. PAL professionally carries out the mandate as well as the obligation to play an active role in supporting the fulfillment of the needs of the marine defense equipment and acts as the main guide (lead integrator) of the marine dimension. Currently, the capability and quality of the design of PT. PAL Indonesia (Persero) has been recognized by the international market. The ships are produced by PT. PAL Indonesia (Persero) has been navigating international waters around the world.
  4. Supporting the Government's policies in realizing the strengthening of the national defense system. Submarine products produced by PT. PAL is evidence of PT. PAL's ability to respond to government policies in the development and strengthening of the defense industry, as Law No. 16 of 2012 concerning the defense industry in Article 4 states that the administration of the defense industry serves to 1) strengthen the defense industry; 2) develop defense industry technology that is beneficial for defense, security, and public interest; 3) increase economic growth and employment; 4) independence of the state defense and security system; and 5) build and improve strong human resources to support the development and utilization of the defense industry.
  5. Achievement of the third stage of MEF. Fulfillment of defense equipment that is packaged in the Minimum Essential Forces (MEF) program currently only reaches 59.9% of the Navy. According to the government's target in 2024, it must be able to achieve the target of 100%. PT. PAL's capability in the construction of submarines is certainly part of the acceleration in the fulfillment of defense equipment towards the Minimum Essential Forces (MEF). Moreover, Jannah, Apriyanto, & Bura (2021) stated that finance is an important factor in the budget used to support the defense industry in realizing the MEF. In the procurement of defense equipment as the embodiment of MEF, budgeting includes loans domestically, both State-Owned Enterprises and Private-Owned Enterprises, and foreign loans or facilities export credit. Meanwhile, policies in the defense industry are the legal basis and guidelines in the implementation of

procurement of weapon systems to realize MEF.

6. Supporting government policies in the use of Domestic Material Level. Two regulations issued by the Central Government include Government Regulation Number 29 of 2018 concerning Industrial Empowerment and Presidential Regulation Number 12 of 2021 concerning Government Procurement of Goods/Services Amendment to Presidential Regulation Number 16 of 2018 concerning Government Procurement of Goods/Services. Through this regulation, all government procurement of goods and services is required to use domestic products, especially domestic products with the sum of the Domestic Material Level and Company Benefit Weight (BMP) values of at least 40%. In the construction of submarines, the policy is also implemented by using the domestic material level of 40%, with this application it is expected to provide stimulation and encourage the use of domestic production.

**Table 3.** Benefit Criteria

No	Criteria	Code
1	PT. PAL's HR capabilities are increasing	B1
2	The independence of PT. PAL as one of the defense industries	B2
3	The capability and existence of PT. PAL is recognized by the maritime world	B3
4	Supporting the Government's policies in realizing the strengthening of the national defense system.	B4
5	Achievement of the third stage of MEF	B5
6.	Supporting government policies in the use of Domestic Material Level	B6

*Source:* Processed by the Authors, 2022

### Determination of Cost Criteria

The obtained cost criteria, as the results of brainstorming with experts in the field, are:

1. Transfer of Technology (ToT) is not fully implemented. The strategy for

developing PT. PAL's workforce skills, including the submarine division in submarine construction, are implemented in the Transfer of Technology (ToT) Program. The purpose of this program is the step to increase the knowledge, skills, quality, and independence to build the next submarine. The Transfer of Technology (ToT) program benefits both parties, from the Indonesian side they will get knowledge about submarine manufacture and on the South Korean side, they will receive the benefits of buying submarines from their country. However, in practice, the company that PT. PAL cooperates with the construction of submarines, in this case, Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME) South Korea also has a profit-oriented business principle, so it is an impossibility if the Transfer of Technology program (ToT) of all knowledge is transferred to Indonesia. This is also detrimental to the company because with the capabilities it has; Indonesia will be free from dependence on submarine technology, both in the aftersales aspect and even in making the next project. On this basis, the Transfer of Technology (ToT) cannot be fully implemented and accepted by PT. PAL

2. PT. PAL is not leading the project. Although based on Law no. 16/2012 and the Decision of the Indonesian Defense Industry Policy Committee, PT. PAL is the lead integrator of the Navy Main Weapon System but in its implementation the movement of PT. PAL is still very limited by its working partner, namely Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME) South Korea. It can be seen that several jobs should not be known and carried out by PT. PAL, some of which are the combat management system (CMS) and radar technology.
3. Limited human resources and production support facilities. Human

resources and complete production support facilities are one of the keys to PT. PAL's success in the development and construction of submarines. The results of the interview with the Head of Maintenance Division of PT. PAL was that the limited human resources and production support facilities became the current obstacles faced by PT. PAL. This statement is supported by Sulistijono (2017) who stated the availability of the number of human resources in PT. PAL is inadequate in facing the amount and level of load work. It resulted in the use of outsources or the services of a sub-contractor by the PT. PAL. Besides, the human resources of PT. PAL do not have enough experience and ability in mastering technology submarine design.

**Table 4.** Cost Criteria

No	Criteria	Code
1	Transfer of Technology (ToT) is not fully implemented	C-1
2	PT. PAL is not a leading project	C-2
3	Limited human resources and production support facilities.	C-3

Source: Processed by the Authors, 2022

**Determination of Alternatives**

In making decisions on the sustainability of the implementation of the Submarine project by taking into account the benefits and costs, they are as follows:

1. Continue to cooperate in the construction of the Submarine Project
2. Discontinue cooperation in the manufacture of the Submarine project

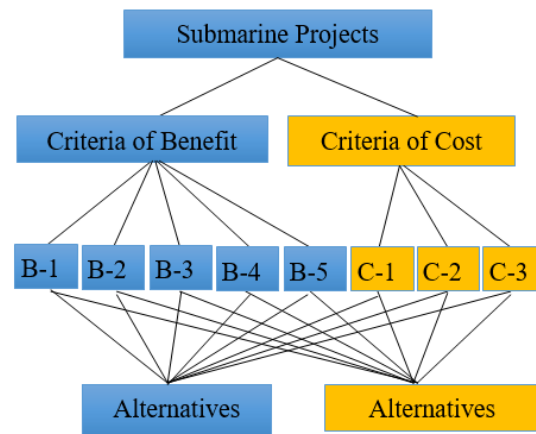
**Table 5.** Alternatives

No	Criteria	Code
1.	Continue to cooperate in the construction of the Submarine Project	A1
2.	Discontinue cooperation in the manufacture of the Submarine project	A2

Source: Processed by the Authors, 2022

**The Processing of AHP**

Before distributing the questionnaires and inputting the results of the questionnaires, the Analytic Hierarchy Process (AHP) model was developed to the objectives and criteria used by the AHP.



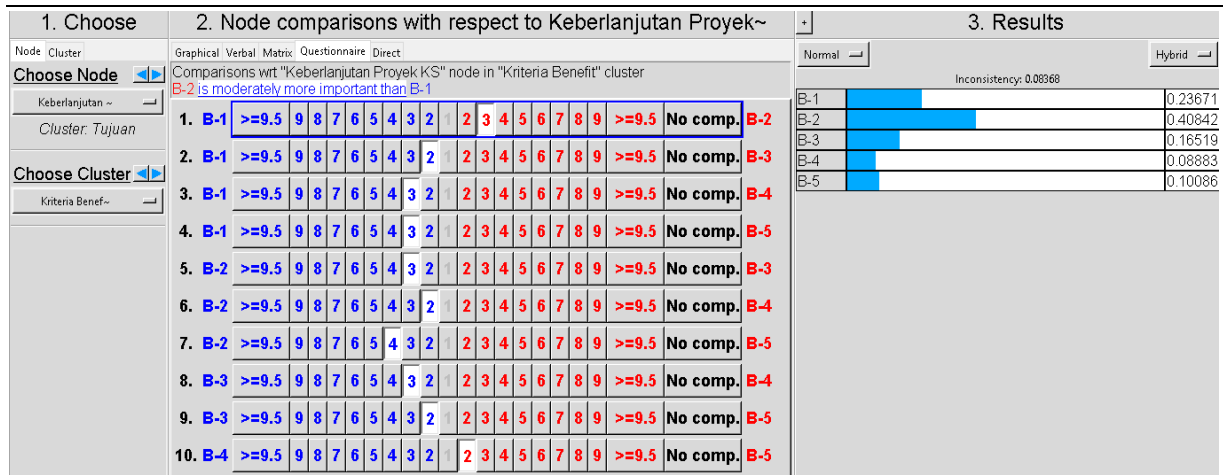
**Figure 2.** Hierarchical Structure

Source: Processed by the Authors, 2022

After the hierarchical structure model is created as shown in Figure 2, then the value of pairwise comparison can be determined between criteria and between alternatives for each criterion. The pairwise comparison value was obtained using a questionnaire. The priority weight value for each category obtained based on the pairwise comparison value will be compared to obtain the final priority weight value.

The data that has been obtained from the questionnaire distribution is in the form of pairwise comparison between the criteria and alternatives. The assessments from the experts will be combined using the geometric mean formula (geometric mean). Furthermore, the calculated geometric mean is then entered into the pairwise comparison matrix in Super Decisions 3.2 software, as shown in Figure 3.





**Figure 3.** Pairwise Comparison among criteria  
 Source: Processed by the Authors through Super decision, 2022

**Table 6.** Inconsistency Value

Criteria	Value	Description
Among Criteria	0,08	Consistent
B-1	0,00	Consistent
B-2	0,00	Consistent
B-3	0,00	Consistent
B-4	0,00	Consistent
B-5	0,00	Consistent
C-1	0,00	Consistent
C-2	0,00	Consistent
C-3	0,00	Consistent

Source: Processed by the Authors through Super decision, 2022

**Here are the priorities.**

Icon	Name	Normalized by Cluster	Limiting
No Icon	A-1	0.56298	0.389755
No Icon	A-2	0.43702	0.302553
No Icon	B-1	0.23671	0.033615
No Icon	B-2	0.40842	0.058000
No Icon	B-3	0.16519	0.023459
No Icon	B-4	0.08882	0.012614
No Icon	B-5	0.10086	0.014323
No Icon	C-1	0.23126	0.038316
No Icon	C-2	0.12727	0.021086
No Icon	C-3	0.07004	0.011604

**Figure 4.** Final Weight of Criteria and Alternatives  
 Source: Processed by the Authors through Super decision, 2022

In addition to filling in the Geomean value in pairwise comparison, inconsistency values must also be considered. The inconsistency value should not exceed 0.1 (Saaty, 1999). If a value > 0.1 is obtained, the questionnaire must be repeated, but if it is still worth > 0.1, the researcher must look for other

sources who better understand the problem being studied. The following inconsistency value of the weighting of this study can be seen in Table 6. Based on the processing of the questionnaire shown in Table 6, the expert opinion in assessing the sustainability of the submarine project is consistent. Based on the results of

calculations using super decisions, the weight values between criteria and alternatives are obtained as can be seen in Figure 4.

In Figure 4, it can be seen that in assessing the sustainability of the submarine project, criteria B-2 (Independence of PT. PAL as one of the defense industries) is very dominant with a weight value of 0.56. Meanwhile, the cost criteria that need to be considered are the C-1 criteria (Transfer of Technology (ToT) is not fully implemented) with a weight of 0.23. Meanwhile, by considering the value of the benefit and cost criteria, the conclusion is that the value of A-1 (continue to continue cooperation in the manufacture of the Submarine Project) has a higher weight of 0.56. From calculations using the analytical hierarchy process (AHP) method, it was concluded that in the context of the sustainability of the submarine project, with the existing risks and benefits, the submarine construction project was continued. This is to the initial plan that the 4th to 12th submarines will be implemented from 2021 to 2042 (Dewan Perwakilan Rakyat Republik Indonesia, 2021) and in line with the Chief of Navy Staff program and desire that in the future each Fleet Command will have a Submarine (Poetra, 2022).

Based on the description above, the Benefit Cost Ratio (BCR) analysis, can still be applied to control even though a project has been decided to be carried out so that with this analysis the project development from year to year can still be controlled. Apart from that, BCR analysis can also be used to evaluate completed projects or work. The purpose of this evaluation is to determine the performance of a project and the results of the analysis that has been carried out can be used for further program improvements (Rinaldi, 2013). Benefit Cost Ratio (BCR) Theory According to Rinaldi (2013) BCR analysis is an analytical approach with a systematic procedure to compare a series of relevant costs and benefits, with an activity or

project. The final goal of this analysis is to compare the two values between benefits and costs, which one is greater. Furthermore, from the results of the comparison of the two benefits and costs, the decision maker can decide whether the project is feasible or not. Meanwhile, in the context of evaluating ongoing projects or program activities, the results of the BCR analysis can be used to determine its sustainability. In use in the field, the Benefit Cost Ratio (BCR) analysis has undergone many developments. The use of Benefit Cost Ratio (BCR) analysis is not only on investment issues but Benefit Cost Ratio (BCR) analysis can also be used on other problems such as the analysis of the sustainability of policy programs in an organization. Benefits can be interpreted as all things that are beneficial in a project, while costs are all things that can be detrimental to a project.

Based on the result of the AHP analysis, the criteria of benefit concerning the independence of PT. PAL as a defense industry reaches the higher score among the other criteria. It indicates that the point of realizing independence in Indonesia's Defense Industry can be considered the main important aspect as it may be followed by other progress or development to support national defense in Indonesia. Independence in the defense industry can also be considered as the independent defense industry to support our defense effort to protect the country. However, the cost that is need to be considered in realizing the independence of PT. PAL as the defense industry is the criteria of Transfer of technology which is not fully implemented in Indonesia. This criterion is considered important as the cost factor since the ToT will enrich the capability of the resources in PT. PAL in realizing the independent defense industry in Indonesia.

That is why the chosen alternative is creating the submarine division followed by realizing its projects to support the realization of PT. PAL is the independent defense industry in Indonesia. This would

be better if it is supported by the commitment of the company and government, especially in facing the cost of reaching the benefit as described before.

### **CONCLUSION, RECOMMENDATION, AND LIMITATION**

Based on the analysis using the analytical hierarchy process (AHP) method and the benefit-cost ratio, the following conclusions are obtained:

1. The weight of the highest benefit criteria is B-2 (Independence of PT. PAL as a defense industry) with a weight of 0.40. It indicates that the point of realizing independence in Indonesia's Defense Industry can be considered the main important aspect as it may be followed by other progress or development to support national defense in Indonesia. Independence in the defense industry can also be considered as the independent defense industry to support our defense effort to protect the country and also to consider continuing the next submarine project.
2. The weight of the highest cost criteria is C-1 (Transfer of Technology (ToT) is not fully implemented) with a weight of 0.23. It means that the cost that is need to be considered in realizing the independence of PT. PAL as the defense industry is the criteria of Transfer of technology which is not fully implemented in Indonesia. This criterion is considered important as the cost factor since the ToT will enrich the capability of the resources in PT. PAL in realizing the independent defense industry in Indonesia is also in consideration to continue the next submarine project.
3. The chosen alternative is A-1, which is to continue cooperation in the construction of the Submarine Project with a weight of 0.56. The chosen alternative is creating the submarine division followed by realizing its projects to support the realization of PT.

PAL is the independent defense industry in Indonesia. This would be better if it is supported by the commitment of the company and government, especially in facing the cost of reaching the benefit as described before.

### **REFERENCES**

- Antoni, H. (2022). Pengembangan Pembangunan Industri Perkapalan Nasional dalam Mendukung Keamanan Pertahanan Indonesia untuk Menjaga Kedaulatan Perairan di Wilayah Indonesia. *Jurnal Maritim Indonesia*, 10(1), 92–102. <https://doi.org/10.52307/JMI.V10I1.105>
- Creswell, J. W. (2010). *Research Design Pendekatan Kualitatif, Kuantitatif, dan Mixed* (Terjemahan). Yogyakarta: Pustaka Pelajar.
- Defender. (2015). *Alutsista Pendukung Poros Maritim*. PT. Strata Pesan Cakti.
- Dewan Perwakilan Rakyat Republik Indonesia. (2021). *Laporan Kunjungan Kinerja Spesifik Komisi VI DPR RI ke Provinsi Jawa Timur dalam Rangka Peninjauan PT PAL Indonesia (Persero) pada Masa Persidangan V Tahun Sidang 2020-2021*. Jakarta.
- Dwiyanto, J. (2006). Metode Kualitatif: Penerapannya dalam Penelitian. Retrieved from [www.inparametric.com](http://www.inparametric.com)
- Efendie, N. A., Kiswara, G. J., & Purboyo. (2022). Pengembangan Kemampuan dan Kemandirian Industri Pertahanan Indonesia (Studi Kerjasama Pengembangan dengan Metode Penta-Helix). *Journal of Industrial Engineering & Management Research*, 3(3), 299–305. <https://doi.org/10.7777/JIEMAR.V3I3.381>
- Fajarta, C. R. (2022, January 24). Panglima TNI Ungkap Capaian MEF, Angkatan Darat Paling Tinggi.

- Retrieved February 23, 2022, from <https://nasional.sindonews.com/read/665943/14/panglima-tni-ungkap-capaian-mef-angkatan-darat-paling-tinggi-1643014863>
- Hidayat, S., & Ridwan. (2017). Kebijakan Poros Maritim dan Keamanan Nasional Indonesia: Tantangan dan Harapan. *Jurnal Pertahanan & Bela Negara*, 7(3), 107–121. Retrieved from <https://jurnal.idu.ac.id/index.php/JPBH/article/view/232/124>
- Jannah, N. F., Apriyanto, I. N. P., & Bura, R. O. (2021). Sinergitas Industri Pertahanan dalam Pemenuhan Minimum Essential Force Matra Laut. *Industri Pertahanan*, 3(1), 48–62. Retrieved from <https://jurnalprodi.idu.ac.id/index.php/IP/article/view/954>
- Periska, A., Siahaan, T., & Aritonang, S. (2020). Analisis Kendala Penggunaan Komponen dalam Negeri pada Produksi Kapal di PT. PAL Indonesia. *Industri Pertahanan*, 2(1), 81–94. Retrieved from <https://jurnalprodi.idu.ac.id/index.php/IP/article/view/543>
- Poetra. (2022, February 8). KSAL: Semua Komando Armada Akan Memiliki Satuan Kapal Selam. Retrieved May 23, 2022, from <https://www.airspace-review.com/2022/02/08/ksal-semua-komando-armada-akan-memiliki-satuan-kapal-selam/>
- PT. PAL Indonesia. (n.d.). Naval Shipbuilding. Retrieved May 23, 2021, from <https://www.pal.co.id/naval-shipbuilding/>
- PT. PAL Indonesia. (2019, April 11). Kapal Selam Pertama Produksi Anak Bangsa Wujudkan Kemandirian Industri Pertahanan Indonesia. Retrieved May 23, 2021, from <https://www.pal.co.id/2020/01/publikasi/perusahaan-kegiatan/kapal-selam-pertama-produksi-anak-bangsa-wujudkan-kemandirian-industri-pertahanan-indonesia/>
- Rinaldi. (2013). *Analisis Pengaruh Pendidikan dan Pelatihan terhadap Kinerja Guru Menggunakan Metode Benefit Cost Ratio (Studi Kasus: SMAN 3 Teluk Kuantan)*. Universitas Islam Negeri Sultan Syarif Kasim Riau, Pekanbaru.
- Saaty, T. L. (1980). *The Analytic Hierarchy Process: Planning, Priority Setting, Resource Allocation*. New York: McGraw-Hill International Book Co.
- Saaty, T. L. (1999). Fundamentals of The Analytic Network Process. *The International Symposium on the Analytic Hierarchy Process (ISAHP)*. Kobe.
- Sulistijono, R. K. (2017). Kemandirian PT. PAL Indonesia (Persero) sebagai Industri Strategis Pertahanan Nasional dalam Pembuatan Kapal Selam Diesel Elektrik Klas 209. *Strategi Perang Semesta*, 3(1), 25–39. Retrieved from <https://jurnalprodi.idu.ac.id/index.php/SPS/article/view/16>
- Susdarwono, E. T. (2020). Pokok-Pokok Pikiran mengenai Pembangunan Kemandirian Industri Pertahanan Indonesia dalam Undang-Undang Nomor 16 Tahun 2012 tentang Industri Pertahanan. *Jurnal Ius Constituendum*, 5(1), 111–139. <https://doi.org/10.26623/JIC.V5I1.1759>
- Wibowo, R. D. (2016). Permasalahan dalam Mewujudkan Kemandirian Industri Pertahanan. *Jurnal Defendonesia*, 1(2), 43–48. Retrieved from <https://ejournal.lembagakeris.net/index.php/Defendonesia/article/view/15/13>
- WIRA: Media Informasi Kementerian Pertahanan. (2020). Sekjen Kemhan: Kemandirian Idhan Penting dalam Mewujudkan Sistem Pertahanan Negara yang Kuat. *Kementerian Pertahanan Republik Indonesia*.