

Potential utilization of the weapon system tank boat in strengthening the defense of Indonesia as a maritime country

Agus Nugraha^{1*}, Yayat Ruyat², Susilo Adi Purwantoro³

¹ Faculty of Defense Technology, Republic of Indonesia Defense University, Indonesia

² Faculty of Defense Technology, Republic of Indonesia Defense University, Indonesia

³ Faculty of Defense Technology, Republic of Indonesia Defense University, Indonesia

*Corresponding author E-mail: sicepe92@gmail.com

Received: Dec. 1, 2022

Revised: Dec. 25, 2022

Accepted: Dec. 26, 2022

Online: Dec. 29, 2022

Abstract

Indonesia is the largest maritime country in the world with 80 percent of its territory in the form of oceans. This makes it difficult to supervise the security and sovereignty of the Republic of Indonesia, especially in the maritime sector. Therefore, it is necessary to design a fast catamaran concept that is good and responsive as a tool for war and security in Indonesia's maritime territory. This study aims to design the concept of a Tank Boat type ship and a weapon system based on domestic weapons technology. The method used is the House of Quality data analysis technique which is the first stage of implementing Quality Function Deployment (QFD) in classifying user needs based on the level of importance so that a priority scale is obtained. From the results of the analysis using the Quality Function Deployment (QFD) method, the level of user needs for ships and weapon systems on Tank Boats based on weapons technology is obtained by determining the Benchmark Performance (BP) value for the highest to lowest design characteristics. In this case, there are several main points for the desired user needs in the operational requirements and weapon systems for the Tank Boat object, including Tank Boat has a lightweight, The weapons used have high precision, Weapons must be free from ITAR (International Traffic Regulations), The flexibility of weapons to be integrated with the vehicle, The main target is a vital target or VVIP, and Security. The results of the study indicate that there is a need for a weapon system on the Tank Boat to support the defense of the Maritime State. This research is expected to be used as a starting point for further research related to ships and weapon systems that can be used on Tank Boat rides.

© The Author 2022.
Published by ARDA.

Keywords: Weapon System, Tank Boat, Quality Function Deployment, Benchmark Performance, Maritime State Defense System.

1. Introduction

Indonesia is the largest maritime country in the world with 80% of its territory in the form of oceans. The total area of Indonesia reaches 7.81 million km² of which 2.01 million km² of land area, thus the area of the Indonesian territorial sea reaches 3.25 million km² and the sea area of the Exclusive Economic Zone (EEZ) reaches 2.55 million km² [1]. The dynamics of the development of the strategic environment, both global, regional, and national, always bring changes to the complexity of threats and challenges to national defense [2]. The complexity of the threat can be seen from the type, perpetrator, and source of the threat. The types of threats and challenges are no longer dominated by military threats, but also by non-military threats. Threat actors are not limited to state actors, but also non-state actors. Both of them can be a threat (hybrid threat) that

is an actual or potential threat. The existence of the nation and state is at stake to face these threats, including Indonesia. Therefore, the national defense policy should be able to face the threats posed by the dynamics of the development of the strategic environment, both nationally, regionally, and internationally. Quite a several foreign warships were detected late and entered Indonesia as a result of the lack of supervision of Indonesia's maritime territory. These conflicts can cause conflicts between countries, especially Indonesia and other countries, which can eventually heat up and trigger military resistance. This is a special task for the state and the TNI to maintain security and sovereignty in the maritime sector by providing regional defense in the form of military attacks using Indonesian alusista to the opposing party. It takes a strong fleet to repel their presence so that the problem does not recur. To enforce a security system at sea, the system must be built using the principle of synergizing forces between all agencies implementing security enforcement at sea. This synergy will create unity in the organizational structure, mechanisms, and procedures for implementing security at sea carried out by its officers with the ultimate goal of upholding sovereignty and sovereign rights as regulated in UNCLOS 1982 [3].

The criteria for fulfilling the Operational Requirements for Tank Boats include being able to operate in Indonesian waters, and being faced with the implementation of the Marine Defense Strategy, which is used as a guideline in deploying operational elements including Tank Boats so that they can have firepower weapons against targets at sea, sea level and strategic targets on land that are deadly, where their presence will have a large deterrence impact and adapt to the development of weapons technology.

Based on the fulfillment of the Minimum Essential Force (MEF) priority for the Strategic Plan (Renstra), through Presidential Regulation (Perpres) No. 42 of 2010, the Defense Industry Policy Committee (KKIP) was formed. KKIP was formed to carry out the task of fostering the domestic defense industry to formulate policies and increase the productivity of defense equipment independently. The MEF, which adjust to the Strategic Plan or to the stages that have been made by KKIP is inseparable from the management of the state defense system that must be fulfilled by the government, in this case not only the fulfillment of the Main Weapon System Equipment (Alutsista) but also the Alutsista modernization program [4].

The chronology of the "ANTASENA" Tank Boat Program began with an oral statement from the Indonesian Minister of Defense, Mr. Gen. TNI (Ret.) Ryamizard Ryacudu about his interest in the Tank Boat program when the Tank Boat model was displayed at the Armored Vehicle Asia (AVA) Conference in April 2015. Work The Tank Boat was realized in collaboration with the Indonesian Defense Industry (PT. Pindad and PT. Lundin Banyuwangi) with CMI Defense from Belgium. With a memorandum of understanding between PT. Pindad (Persero), PT Lundin, and CMI Defense S.A which was held on September 10, 2015. The use of the Alutsista Tank Boat has a very strategic meaning because the threat to state sovereignty, especially in the field of transnational crime and infiltration from outside the territory of Indonesia through a 12 nautical mile territorial area is very high. The Indonesian archipelago bordering neighboring countries is close to each other and requires extensive patrol monitoring. Therefore, security vulnerabilities across territorial sea borders, if only rely on the capabilities of the TNI-AL, POLAIRUD, or other Marine Security Institutions. With so many straits, bays, or sea boundaries that have a level of security threat and traffic that is vulnerable to the presence of security elements, it is necessary to develop and initiate other dimensions that cannot be separated from the duties of the TNI by Law 34 concerning the TNI. the role of the Infantry unit at the level of the Infantry Battalion can help increase the level of security in the 12 nautical mile territory if it is equipped with a Tank Boat with an adequate firing range.

Furthermore, during the presentation of the Tank Boat program to the Minister of Defense on January 6, 2016, the Minister of Defense expressed full support for the Tank Boat program to be realized and realized where funding is planned from the Ministry of Defense through APBN-P. Director General Pothan Kemhan conveyed to the President Director of PT. Pindad on March 8, 2016, about the planned funding support and assignment of Tank Boat Prototype development activities which were followed up with a cooperation agreement between PT. Pindad and PT. Lundin on 10 June 2016, which arranged the contribution of each party to the Tank Boat program.

The innovation of a system for purchasing military weapons equipment is very important because it aims to reduce the burden of foreign exchange and the effect on the balance of payments, thereby stimulating the development of the domestic defense industry. The choice of weapons has a very political impact, if there are conditions that hinder the development of a defense posture such as an embargo, then innovation and planning

are needed to design an independent weapon system because this is an important part of the transition mechanism for procurement and replacement of weapons systems [5].

Organizationally, the Infantry Battalion is divided into six types of Infantry Battalion based on three typologies of the area, namely urban, mountain forest and sea, river, and coastal swamps. For Infantry Units to be able to carry out tasks in various areas of the Republic of Indonesia, transportation equipment in the water is needed that can operate effectively and efficiently with reliable maneuvers and maximum firepower in these areas.

Based on the above background, the researcher formulates the problem and makes the research question, namely How is the potential utilization of the weapon system tank boat in strengthening The Defence of Indonesia as a maritime country? To answer the formulation of the problem above, the researcher uses several theories related to the Potential Utilization of the Tank Boat Weapon System in Strengthening Indonesia's Defense as a Maritime State. In seeing the potential use of the Tank Boat weapon system in strengthening Indonesian defense, a strategy is needed to maximize the utilization of the resources owned. By definition, strategy is an action or activity carried out by an organizational leader in achieving the goals that have been set by using the resources they have. Strategy theory is more planning (planning) which connects all existing aspects (means) and uses them optimally [6]. Strategy talks about schemes and steps to achieve a goal. Carl Von Clausewitz's opinion in his book *On War* states that strategy is the use of engagement for war. The strategy focuses on the use of strength in carrying out engagement efforts to achieve goals. Strategy theory explains how to determine goals for all existing elements to support the process of achieving goals. The existence of a strategy is very important to guide steps in the development of an uncertain situation. The strategy assumes that the future cannot be predicted but that the strategic environment can be studied and accessed to be able to formulate anticipatory steps. Adds if the strategy is implemented by applying ends, ways, and means in a strategic environment to achieve the desired goals [6]. Ends is an objective or goal to be achieved by considering the variables contained in the strategic environment. These goals are contained in the policies made by the state to achieve strategic results in realizing an interest. Ways is a strategic concept to answer how to achieve certain goals by applying national power (1). Mathematically, strategy is assumed to be a means plus a goal, with the formula $St = W + M + E$ with description: St (Strategy) = Strategy, W (Ways) = The way to reach the goal, M (Means) = Resources, facilities, and infrastructure that can be used to achieve goals, and E (Ends) = Goals defined in the policy.

This conception will narrow down to the question of who does what, where, when, how, and why. The strategic concept must be able to provide guidelines for the implementation and implementation of national power to achieve national goals. In formulating a strategy, of course, one must take into account in detail measurable related ends, means, and ways. This is important for success in achieving goals. The means are a limitation for the type and level of supporting elements in encouraging the achievement of a goal. In strategy, means can be tangible or intangible. For example, tangible means include forces, people, equipment, money, and other supporting facilities. Meanwhile, intangible means include a will, courage, spirit, and intellect [6].

The development of technology, especially technology in the field of weapons, has become a threat that is realized through an increasingly strong military force, considering that countries in the world are currently trying to allocate defense budgets for the sake of increasing and developing their military strength as the main mission of self-defense (self-defense). research on weapons technology and the purchase of high-tech military equipment from other countries. Threats are the main factors that form the basis for drafting the design of the national defense system, both actual and potential.

State defense efforts are carried out through the development of the national defense posture. The development of the national defense posture is carried out on an ongoing basis to realize strength, capabilities, and titles. The development of the military defense posture is directed at fulfilling the Minimum Essential Force (MEF) of the main components and preparing other defense components. The military defense posture consists of Main Components, Reserve Components, and Supporting Components, which are directed through building strength, abilities, and titles. The military defense posture is prioritized to deal with actual threats by not ruling out potential threats and other threats. In the 2015 Defense White Paper of the Republic of Indonesia, it is explained that the TNI's Posture includes 3 things, namely strength, ability, and title. In the context of the use of the tank boat weapon system in strengthening Indonesia's defense as a maritime country, it requires development in the aspect of equipment developed through various plans. Quality Function Deployment (QFD) is a method used to develop and plan products so that the development team can specify in detail the needs and desires of customers [7]. Meanwhile, Daetz explains that QFD is a systematic planning

process created to help companies organize all the elements needed to define, design, and manufacture products or provide services that can meet customer needs [8]. Broadly speaking, Quality Function Deployment is a systematic planning process that was created to help an agency or company to be able to manage all elements that can design, define, and create products or provide a service that can meet customer needs.

The main tool of QFD is the arrangement of matrices by collecting, interpreting, documenting, and prioritizing customer requirements. The starting point for QFD is the customer and the wants and needs of the customer (voice of the customer). The QFD process starts with customer needs and then continues through 4 main points, namely Product Planning, Product Design, Process Planning, and Process Control Planning.

In addition, there is a House of Quality, which is the first stage in implementing QFD, formed by compiling one or more matrices that are interconnected and developed to determine the relationship between customer needs and technical parameters of the product or service. This matrix explains what the customer's needs and expectations are and how to fulfill them. The stages in implementing it are through 3 phases, namely the first phase by collecting customer needs (Voice of Customer), the second phase by compiling the House of Quality, and the third phase of analysis and interpretation of the previous stages. This phase is carried out in various ways in each phase.

Research with the same topic is not widely carried out, but there is one study that discusses the optimization of the shape of the catamaran ship demihull to improve the quality of seakeeping which is also discussed in this study, but this research has differences in the optimization of the shape of ship demihull to improve the quality of seakeeping following the standards of general seakeeping criteria for military ships. The demihull form used is NPL Hull Form Series 4b

2. Research method

This study uses a qualitative method with an emphasis on an object in this case the Tank Boat. Research using the qualitative method is defined as a research procedure that produces descriptive data in the form of written or spoken words from people [9]. One of the research designs that can be used in qualitative research and is considered suitable for this research is the case study approach, namely the design of the weapon system on the Tank Boat through the System Engineering Approach. The research design that is used as a reference is considered suitable because it is following the theory from the Design System Engineering Approach book [10] which states that to carry out development, research must at least have standard stages starting from the User Need phase, Conceptual Design, Preliminary Design, Detail Design, Production/Construction, and Product Use, Support, and Disposal. This research focuses on Conceptual Design with the implementation of the System Life Cycle in the Acquisition Phase including user needs and Conceptual Design.

3. Results and discussion

The potential use of the Tank Boat weapon system in strengthening Indonesia's defense as a maritime country.

3.1 Platform "Tank Boat"

After obtaining the criteria from the operational requirements, then the determination of the platform of the "Tank Boat" is based on the number of components that will be installed on the ship. The components that will be installed on "Tank Boat" can be seen in Table 1.

Table 1 Platform "Tank Boat" Components

No	Component	Amount	Dimensions L x B x H (mm)	Weight (Kg)
1	Main Engine	1	Dimensions [P × P × T] (mm) 1812x1293x1414	2300
2	Thermal camera	1	15.18" X 18.68" x 50 x 30	30
3	Turret	1	12 m	4000
4	Life raft	2	900 x 550 x 380	56
5	Navigation Bridge Sistem	1	According to Spesification	250
6	RGB	1	P=7800, W=2500	450
7	Battery 12 V	8	578 x 254 x 219	200
8	Thrust Vectoring	1	Suitable for Turbojet engines	200
9	AE	2	1029 x 629 x 251	824

10	Frest Water	2	In Accordance GA	100
11	Fuel oil	10	In Accordance GA	142
12	Diesel oil	2	In Accordance GA	428
13	Crew	4	-	360
Total Weight				8320

Table 1 shows the number of components along with their dimensions and total weight. The total weight of this component will be used as the ship's payload. So the payload of the Tank Boat is 8320 Kg.

3.2 Ship design stages

The process of designing a ship is iterative, that is, all planning and analysis are carried out repeatedly to achieve maximum results when the design is developed. The spiral design is divided into 4 stages, namely: concept design, preliminary design, contract design, and detail design [11]. In this study, the design of the Catamaran Tank Boat warship was only limited to concept design. Therefore, the design process discussed is only a concept design.

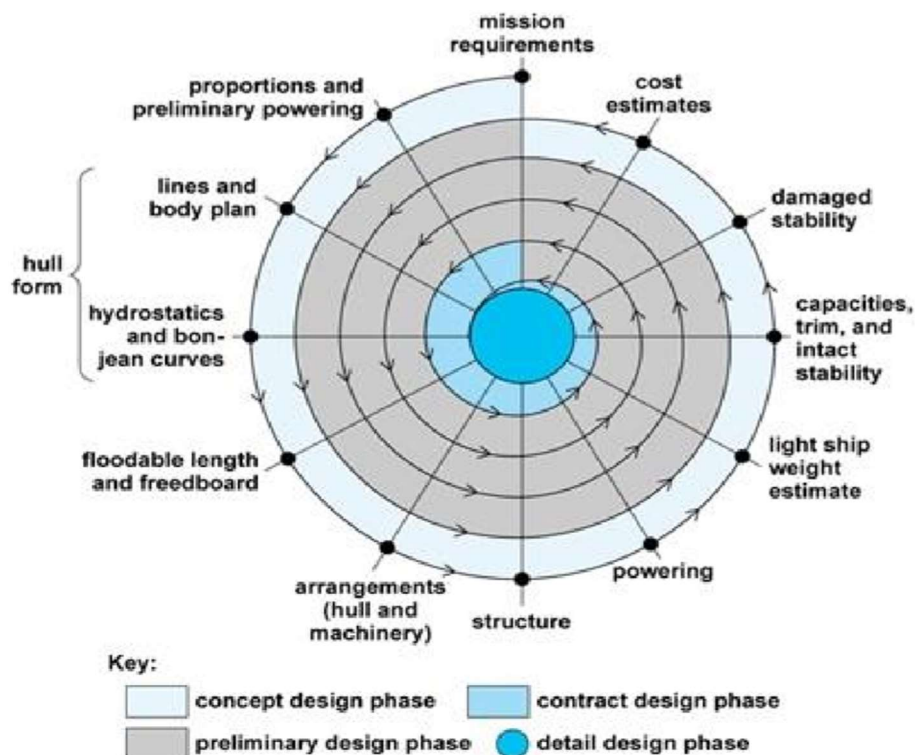


Figure 1. Spiral Design Stages [12]

There are four stages in this Design Spiral, including the following.

3.2.1 Concept design

Concept design is an advanced stage after the Owner's requirement. The concept of ship design is the designer's task to define an object to fulfill mission requirements and comply with existing constraints/problems. To create a concept, approach formulas, curves or experience are used to make initial estimates that aim to get an estimate of the cost of building a ship. The results of this design concept stage are generally in the form of drawings or sketches, either partially or completely

3.2.2 Preliminary design

Preliminary design is the second stage in designing the ship. Preliminary design is a further technical endeavor that will give more detail to the design concept. In conjunction with the spiral diagram, the preliminary design is the second iteration or the second path in the spiral diagram. What is meant by detail includes features that have a significant impact on the ship, including the initial approach to the costs required. Examples of adding details are the calculation of the longitudinal strength of the ship, the development of the midship section of the ship, a more accurate calculation of the weight and center of gravity of the ship, draft, stability, and others.

3.2.3 Contract design

The contract design stage is an advanced stage after the preliminary design stage, namely the development stage of ship design in a more detailed form that allows shipbuilders to understand the ship to be built and accurately estimate all shipbuilding costs. The main purpose of the design contract is to produce a document that describes the ship that will be built soon. Furthermore, these documents will be the basis of the contract or development agreement between the ship owner and the shipyard. The components included in the contract design are as follows: (1) Arrangement Drawing, (2) Structural Drawing, (3) Structural Details, (4) Propulsion Arrangement, (5) Machinery Selection, (6) Propeller Selection, (6) Generator Selection, (7) Electrical Selection.

The components above are also known as key plan drawings. The key plan drawings must present in detail the ship's features according to the request of the ship owner or ship owner.

3.2.4 Design details

Detail design is the last stage of the process of designing a ship. At this stage, the results of the previous stages will be developed into a more detailed working drawing as a whole. Ship construction plans will be discussed in detail at this stage.

The biggest part of this process is the production of working/field drawings required in the production process. The purpose of this Tank Boat design is to determine the operational requirements of the Catamaran Combat Boat assault warship, obtain the main size of the Catamaran Tank Boat assault warship and obtain the lines plan and general plan of the Catamaran Tank Boat assault warship with Turbojet.

Before entering the calculation process and the design stage, it is necessary to plan the criteria that will be used for the Tank Boat starting from the criteria that have the most influence on the design process.

The criteria are the type of hull and material. For a detailed explanation, see the following sub-sections:

3.2.5 Hull type

From the decision tree image, we get three types of hulls as the preferred candidate for the Tank Boat. The three types of hulls have advantages and disadvantages, as follows:

1) Monohull is a hull monohull type that has shortcomings in terms of stability, easy rolling, and relatively small deck area

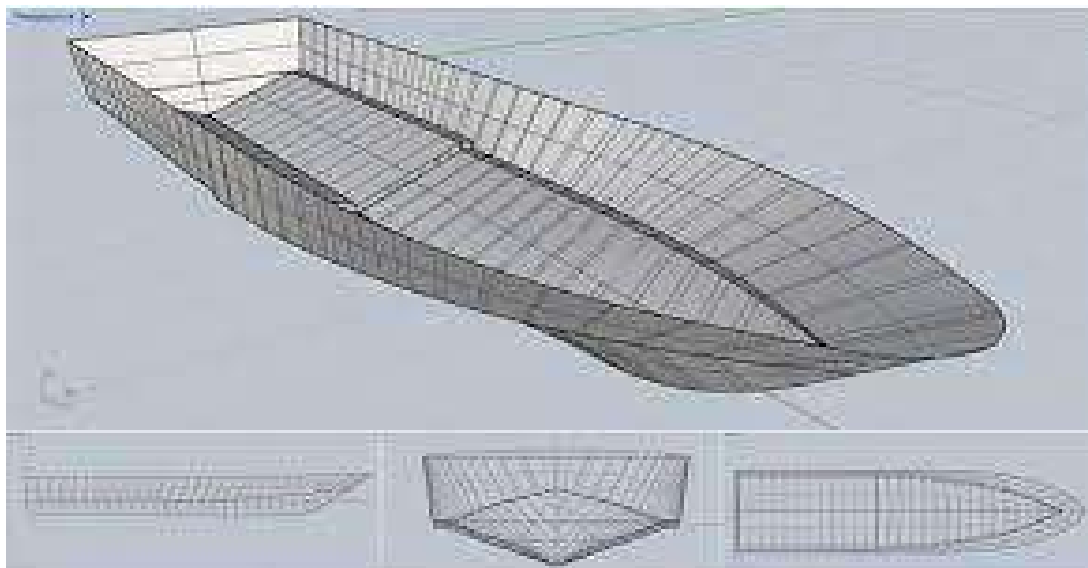


Figure 2. Mono Hull [13]

2) The catamaran has the advantages of a catamaran hull compared to a monohull hull, namely:

- a) Large deck area.
- b) Can maintain speed in the sea with high waves.

- c) Have a stable platform.
- d) More cost-effective than other hull types with the same capability.

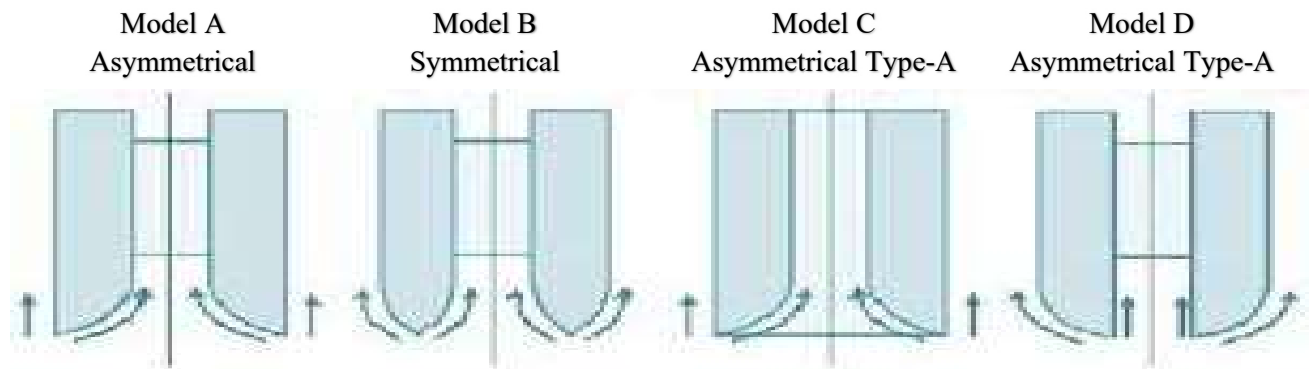


Figure 3. Multi-Hull Catamaran

Based on the research of Prof. Jacob Van Renen Van Niekerk who already has experience and expertise in the shipping field, the fully asymmetric type C catamaran hull has the advantage that it is suitable for the design of the Tank Boat catamaran. Some of the advantages of a fully asymmetric type C hull are described as follows [14]:

- (a) The wave interference in the bridge section is smaller than that of a symmetrical catamaran
- (b) Can sail well even in waters with high waves and can slide sideways safely when the ship changes direction drastically.
- (c) Very good stability (will reverse only if there is a very large increase in load).

3.3 Material

Two types of material are obtained as the preferred candidates for Tank Boats, namely the type of material system that has advantages and disadvantages, as follows:

3.3.1 Carbon fiber composite

This type of material has the characteristics of lightweight material, can be stronger than good strength, more flexible to form, and free of corrosion.

3.3.2 Aluminum

The type of material that will be used for the Tank Boat is aluminum. Several things are considered in the selection of aluminum, namely, it has been used for naval ships around the world, the material is lighter than steel, increases camouflage ability, and corrosion is 100x slower.

From these considerations, the type of material to be used is Carbon Composite. The selection of this type of material is based on the design criteria of the Tank Boat to be made, where the ship must have greater strength than other ship materials. In addition, the selection of carbon composites is because this type of material has been tested and has a low density, thereby reducing the ship's load. For the Tank Boat design that is more supportive of field operations, it was chosen to use the Catamaran design with a lighter carbon composite material so that operations can be carried out in shallow waters.

After the previous stages have met the operational requirements, the next step in the ship design process is the process of determining the method of designing the ship. In general, the methods in ship design are as follows.

A **parent design approach** is one method of designing ships by comparing existing ships with designs to be made, namely by taking the main size of a ship that has been previously designed with the provision that the ship must have the same characteristics as the ship to be designed. In this case, the designer already has a reference to the same ship as the ship to be designed. The advantage of the parent design approach is that it can design ships faster because there is already a reference for the ship, it only remains to repair and improve the performance of the ship, and the parent ship's performance is proven (stability, motion, resistance)

The **Trend Curve approach** method which is often referred to as the statistical method is a method/method of designing ships by using regression from several comparison ships to determine their main size. In this method, the sizes of several comparison vessels are compared where the variables are connected and then a trend line is drawn that applies to the ship to be designed.

The **Iterative Design Approach** is a ship design method based on a cyclical process of prototyping, testing, and analyzing. Changes and improvements will be made based on the results of testing the latest iteration of a design. This process has the aim of improving the quality and functionality of an existing design. The ship design process has an iterative nature which is most commonly described by a design spiral that reflects the design methodology and strategy.

The **parametric design approach** is a method used in designing ships with main dimension parameters which are the results of regression from several comparison ships, then calculating the resistance (R_t), designing the propellers, calculating the estimated main engine power, calculating the number of crew members, calculating the center of gravity, trims, and others.

The **optimization method** is used to determine the optimum main size of the ship and the required motor power at the basic design stage. In this case, the optimum design is sought by finding the design that will minimize the economic cost. The parameters of this optimization are the laws of physics, cargo capacity, stability, freeboard, trim, and ship price.

4. Conclusions

The potential utilization of the Tank Boat weapon system in strengthening Indonesia's defense as a maritime country is using the Quality Function Deployment (QFD) method, determining customer requirements is the most important and fundamental part of explaining the needs desired by users in this case, namely the Indonesian Army. These needs include the operational requirements that must be possessed by a Tank Boat to carry out its mission as a combatant as well as the weapons system requirements used. In this case, there are several main points for the desired user needs in the operational requirements and weapon systems for the Tank Boat object, including:

- a) Tank Boat is lightweight.
- b) The weapons used have high precision.
- c) Weapons must be free from ITAR (International Traffic Regulations).
- d) The flexibility of weapons to be integrated with the vehicle.
- e) The main target is a vital target or VVIP.
- f) Security.

From the results of the analysis using the Quality Function Deployment (QFD) method, it was obtained the level of user needs for ships and weapon systems on Tank Boats based on domestic weapons technology produced by the Private and National Defense Industries, namely PT Lundin, PT LEN, PT Hariff, and PT. Pindad by determining the Benchmark Performance (BP) values for the highest to lowest design characteristics shows the results of the Benchmark Performance and Priority Scale values that have been sorted and arranged, namely design characteristics that have priority scales in order.

Declaration of competing interest

The authors declare that they have no any known financial or non-financial competing interests in any material discussed in this paper.

Funding information

No funding was received from any financial organization to conduct this research.

References

- [1] Roza, E. "Maritime Indonesia, Extraordinary Luxury", <https://kkp.go.id/artikel/2233-maritim-indonesia-kemewahan-yang-luar-biasa>, 2017 (Accessed on 27 March 2022).
- [2] National Defense Policy, https://ppid.kemhan.go.id/assets/attachments/20210721_57jakhaneg-2021-oke, (accessed on 23 January 2022).

-
- [3] Soedewo A., "Enforcement of Provisions for Foreign-flagged Ships to Pass in Indonesian Archipelagic Sea Lanes (Alki) II Viewed from the Perspective of Indonesian State Law and United Nations Convention On The Law Of The Sea (Unclos) 1982", Student Journal of the Faculty of Law, University of Brawijaya, 2015.
- [4] BPKP B. P, "Presidential Regulation (Perpres) Number 42 of 2010". Jakarta: Sekretariat Kabinet Republik Indonesia, 2010.
- [5] Prasetyo T. A, "KKIP Performance Evaluation in Republic of Indonesia-South Korea Cooperation in Submarine Development to Support Resilience", Journal of National Resilience, Vol 23, No 21, pp 88-89, 2017.
- [6] Yarger H. R., Strategic Theory for the 21st Century: The Little Book on. USA, Blackswell Publisher, 2006.
- [7] Cohen L, Quality Fuction Deployment: How to Make QFD Work for You, AddisonWesley Publishing Co, Massachusetts, 1995.
- [8] Daetz D. B, Customer Integration: The Quality function Deployment (QFD) Laders Guide for Decision Making, John Wiley & Sons Inc, New York, 1995
- [9] Moleong L. J, Qualitative Research Methodology, PT Rosdakarya, Bandung, 2018.
- [10] Sadraey M. H, Aircraft Design A System Engineering, John Wiley & Sons, USA, 2013.
- [11] Watson D. G, Practical ship design, Elsevier, Vol 1, 1998.
- [12] Naval Architects Australia, Retrieved from web link [navalarchitectsaustralia.blogspot.com: https://navalarchitectsaustralia.blogspot.com/](https://navalarchitectsaustralia.blogspot.com/).
- [13] Zubaer H., U. B, "Twin Step Hull Variation Analysis on a 15-Meter ALU Pilot Boat Using the CFD Method", Jurnal Teknik Perkapalan, 2018.
- [14] Niekerk J, "Comparison of Catamaran Hull Type", Issue of Power Multihull Magazine, 2000.