

Wing-In-Ground-Effect (WIGE) Craft in Labuan Bajo, Is It Feasible?

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Abstract

As an archipelagic country, Indonesia has many tourism destinations, including Komodo National Park (KNP) in Labuan Bajo, East Nusa Tenggara, which is promoted as a strategic area of tourism in Indonesia. Tourism is an integrated activity that requires transportation support to facilitate the mobility of tourists from one location to another. Given its archipelagic geographical characteristics, the use of ships for passenger transportation is very suitable in KNP, Labuan Bajo. One type of vessel that is currently widely used for commercial and tourism transportation is the Wing-In-Ground-Effect (WIGE) craft. Until now, WIGE craft has never been operated in Labuan Bajo KNP. As an investment, operating a ship in a certain area requires a feasibility assessment. Based on this background, this study analyzed the feasibility of operating the WIGE craft in KNP, Labuan Bajo, using the TELOS (Technical, Economic, Legal, Operational, and Scheduling) analysis. The results of the analysis show that, in general, WIGE craft is feasible for investment for a specific segmented consumer in KNP, Labuan Bajo. This study recommends support from various stakeholders, such as regulators and shipyards, for sustainable operations. For further research, feasibility studies may be conducted on other types of WIGE craft and amphibious aircraft.

Kata kunci: Feasibility study, Labuan Bajo, tourism, wing-in-ground-effect craft.

Abstrak

Wing-In-Ground-Effect (WIGE) di Labuan Bajo, Apakah Layak?: Sebagai negara kepulauan, Indonesia memiliki kekayaan destinasi wisata seperti Taman Nasional Komodo/ Komodo National Park (KNP) Labuan Bajo di Nusa Tenggara Timur yang dipromosikan sebagai kawasan strategis pariwisata. Aktivitas pariwisata merupakan kegiatan terintegrasi yang membutuhkan dukungan transportasi untuk mobilitas wisatawan dari satu tempat ke tempat lain. Dengan wilayah geografis berupa kepulauan, penggunaan kapal untuk angkutan penumpang sangat cocok di KNP Labuan Bajo. Salah satu jenis kapal yang saat ini banyak digunakan untuk angkutan komersial dan pariwisata adalah kapal Wing-In-Ground-Effect (WIGE). Hingga saat ini, kapal WIGE belum pernah dioperasikan di KNP Labuan Bajo. Sebagai investasi, mengoperasikan kapal di suatu wilayah memerlukan penilaian kelayakan. Berdasarkan latar belakang tersebut, studi ini akan menganalisis kelayakan pengoperasian kapal WIGE di KNP Labuan Bajo melalui analisis TELOS (Teknis, Ekonomi, Hukum, Operasional, dan Jadwal). Hasil analisis menunjukkan bahwa secara umum, kapal WIGE layak untuk diinvestasikan bagi segmen konsumen tertentu di KNP Labuan Bajo. Studi ini merekomendasikan dukungan dari berbagai pemangku kepentingan seperti regulator dan galangan kapal untuk operasi yang berkelanjutan. Untuk penelitian lebih lanjut, studi kelayakan dapat dilakukan untuk kapal WIGE dengan jenis lain dan pesawat amfibi.

Keywords: Labuan Bajo, pariwisata, studi kelayakan, wing-in-ground-effect craft.

1. Introduction

Indonesia, an archipelagic country with thousands of islands scattered from west to east, is famous for its tourism destinations that offer natural and unique experiences. Tourism activity in a region generates positive impacts across various sectors, such as the economy and society [1]. Transportation is an important sector for tourism, as it enables travel between destinations quickly and efficiently [2]. Komodo National Park (KNP) in Labuan Bajo is a tourism destination in East Nusa Tenggara and is promoted as a strategic tourism area in Indonesia [3]. Labuan Bajo offers various attractions, such as beautiful panoramic views from the top of Padar Island, trekking trails in the natural habitat of Komodo dragons on Rinca Island, walking paths along the Pink Beach, various diving spots, and more. To reach these destinations, tourists must choose several main modes of transportation [4]. Given the vast area consisting of many islands, transportation is essential for tourists to explore all the tourism sites. These days, the primary mode of transportation in Labuan Bajo is maritime transport, particularly Phinisi Yachts

[5]. Phinisi Yachts offer a unique travel experience with several options, ranging from standard vessels to luxury yachts, as well as day-trip packages lasting from two to four days [6]. Since many tourism destinations in Labuan Bajo are located in coastal areas, tourists may also consider fast vessels for transportation. Wing-in-ground-effect (WIGE) crafts can be deployed for cruising by utilizing the ground effect, a natural phenomenon known to improve the efficiency of airplanes during take-off and landing [7]. Due to their efficiency and classification as fast vessels, WIGE crafts have the potential to become favored modes of transportation for medium-distance travel in coastal regions [8]. One available type of WIGE craft is Airfish 8. To date, WIGE crafts have never been operated in Labuan Bajo. Therefore, a feasibility assessment for investment is needed. Based on this background, this study analyzes the feasibility of operating a type A WIGE craft from technical, economic, legal, operational, and scheduling perspectives.

2. Method

2.1. Literature Review

The literature used in this study consists of primary and secondary sources. Based on the research topic, the literature review is divided into several aspects, including tourism, transportation, WIGE craft, and project feasibility.

Tourism is a social, cultural, and economic phenomenon that entails the movement of people to countries or places outside their usual environment for personal or business/professional purposes. These people are called visitors (which may be either tourists or excursionists; residents or non-residents). Tourism has to do with their activities, some of which involve tourism expenditure [9]. This general definition has been further interpreted by researchers and professionals. As a social activity, tourism creates relationships, correspondence, and interactions between people and the environment [10][11][12][13][14]. The most significant activity in tourism is travel, or the movement of people from one place to another, either domestically or internationally, with the aim of gaining experiences [15][16][17]. As an activity that plays an important role and is inseparable from tourism, transportation is a key consideration for tourists in planning their travel to certain destinations. This consideration is influenced by aspects such as distance, finance, facilities, risk, and regulation [18][19][20][21][22][23][24][25].

WIGE craft (Shown in Figure 1) is a vessel with wings that cruises just above the water surface using high-pressure air between its wing and the water surface, categorized as a high-speed craft [26][27]. Operating a commercial vessel like WIGE craft in a certain area is an investment that requires a feasibility study as a consideration to decide whether or not to carry out a pilot project [28][29][30].

In general, the similarities between the literature review and this study lie in the perception that tourism activity is a social activity that requires transportation support. Meanwhile, the operation of special transportation modes requires a feasibility study. However, there are still differences between previous studies and this research. The use of the Airfish 8 WIGE craft as the object of research is something that has never been conducted in KNP. In addition, in the assessment of several feasibility aspects, there are gaps that will be addressed in this study through different methods and described in detail in the next section.



Figure 1. WIGE Craft

3. Results and Discussions

Technical feasibility analysis is an assessment of the suitability of the application of technology at a location. In this case, it involves a new model of a ship. The WIGE craft, as a ship, was analyzed for its suitability for operation in the water area of KNP in Labuan Bajo. The analysis was carried out by comparing the ideal cruising height of the ship with the oceanographic conditions of KNP in the Labuan Bajo area. Oceanographic analysis was conducted using an annual series database of ocean wave characteristics with a period of 15 years. Analysis results produced wave roses as follows.

Based on technical specifications, the Airfish 8 can cruise in calm sea conditions up to moderate breeze levels. The influence of the Wing-In-Ground-Effect in normal conditions can lift this ship to an average height of two meters above sea level. In emergency conditions, such as maneuvers to avoid obstacles, the ship can be raised to a height of seven meters. It can be concluded that the Airfish 8 is safe to operate in the waters of Labuan Bajo for approximately 75% of effective days in one year, or around 292 days, according to the wave rose in Figure 4. Safety feasibility assessment was carried out by analyzing the risk of ship collisions. The risk of a WIGE craft collision with another ship (Phinisi Yacht) was analyzed under three scenarios, namely the probability of a collision in the head-on position, overtaking, and crossing.

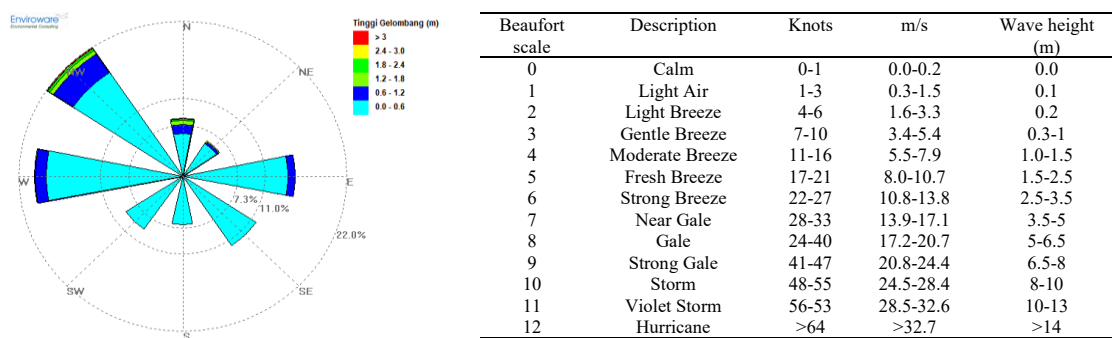


Figure 4. Wave Rose in Labuan Bajo (Left) and Beaufort Scale (Right)

The results of the analysis in Figure 5 show that the probability of a ship collision in the waters of Labuan Bajo is quite low. The highest collision risk probability occurs at a crossing position where another ship is considered to be an obstacle. To avoid obstacles, the WIGE craft can be raised to a cruise height of seven meters. This height is sufficient to avoid collisions with smaller speed boats, but it may be difficult to avoid Phinisi Yachts, which have masts with a height of more than seven meters in a perpendicular crossing position. To minimize the risk of collision, WIGE operations can be conducted by lowering the cruising speed and changing the maneuvering angle of the ship towards the stern of the obstacle ship so that a safe distance is obtained. Economic or financial feasibility can be assessed from several indicators, namely Internal Rate of Return (IRR), Net Present Value (NPV), Payback Period (PP), and Return on Investment (ROI). Variables that need to be considered include capital costs, operational costs, and voyage costs. Furthermore, these variables can be adjusted using tariff variation schemes. The results of the analysis can be seen in Table 1 to Table 3.

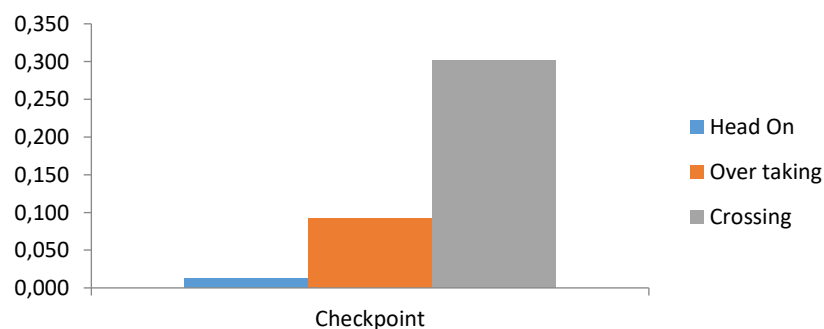


Figure 5. Ships collision probability

Table 1. Cost recapitulation (in Million Rupiah)

Component	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
WIGE Price Unit	51.800,															
Capital/Financing Cost		2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1	2.546,1
Manning Cost		620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7	620,7
Maintenance Cost		665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1	665,1
Insurance Cost		1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2	1.862,2
Fuel Cost		429,8	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1	1.908,1
Port Cost		1.190,9	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6	621,6
Administration Cost	157,5	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1	315,1

Table 2. Financial cash flow and calculation (in Million)

Financial Component	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Total Cost	51.957,5	7.630,4	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3	8.539,3
Total Benefit	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016	14.016
Net Cash Flow	-37.941,5	6.385,5	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6	5.476,6
Cumulative Cash Flow	-37.941,5	-	-	-	-	-	-	1.303,6	6.780,2	12.256,8	17.733,4	23.210	28.686,6	34.163,2	39.639,8	45.116,4
Fraction Calculation		n/m	n/m	n/m	n/m	n/m	n/m	0,76	0,23	1,23	2,23	3,23	4,23	5,23	6,23	7,23
Discount Rate BI 2020	4%															
NPV	Rp240.789,3															
IRR	12%															
ROI	-0,73	0,83	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64	0,64
Payback Period	7	Years														

Table 3. Feasibility indicator

Indicator	Tariff (Rp/pax/trip)		
	Rp5000.000, -	Rp6.000.000, -	Rp8.500.000, -
NPV	Rp1.220.010.765.696	Rp1.493.373.809.925	Rp2.176.781.420.497
IRR	2.31%	12%	36%
ROI (first year in 15 years)	-0.775201314	-0.730241576	-0.617842233
Payback Period	13	7	3

The feasibility of operating WIGE with a 15-year operational period, as shown sequentially from Table 1 to Table 3, must match the indicators, namely a positive NPV value, an IRR that is higher than the interest rate, an ROI that has a positive trend, and a PP that is achieved before the scenario period ends. Based on variations of the tariff scheme, the higher the tariff set, the greater the profit received and the faster the return on investment. This condition will be inversely proportional to a low tariff scheme. The ROI value will only be negative in the first year, but in the subsequent years, it will be positive. In the low tariff scenario, it appears that the IRR is lower than the interest rate. Therefore, in this scenario, it is necessary to consider revising the tariff so that the IRR is higher than the interest rate. In the previous analysis, a tariff formulation scenario was considered profitable for WIGE operators, but the operation of WIGE crafts in Labuan Bajo will lead to direct competition with tourist transportation operators there. Consumers will consider the competitive advantages of the available modes, for example by comparing the rates and types of services obtained between WIGE and Phinisi Yachts. WIGE, as a high-speed craft, offers advantages in terms of cruising speed, allowing tourists to visit all the main attractions in Komodo National Park. On the other hand, Phinisi Yachts operate at a slower speed, requiring each trip to take more than two days. Therefore, the packages offered by Phinisi Yachts include consumption and accommodation at the lowest rate of around IDR 2 million per person. This rate can increase according

Table 4. Comparison of classification regulations

IMO Regulation	LR (chapter)	BKI (section)
Bouyancy, Stability and Subdivision	1	2
Structures	2	3 and 12
Accommodation and Escape Measure	3	6
Directional, Attitude and Altitude Controls System	4	4
Anchoring, Towing and Berthing	5	9
Fire Safety	6	5
Life-saving Appliances and Arrangements	7	6
Machinery	8	7
Auxiliary Systems	9	7
Remote Control, Alarm and Safety Systems	10	7
Electrical Installations	11	8
Navigational Equipment	12	8
Radio communications	13	8
Operating Compartment Layout	14	3
Aerodynamic Stabilization Systems	15	1
Handling, Controllability and Performance	16	9
Operating Provisions	17	10
Inspections and Maintenance Provisions	18	10 and 11

Table 5. Availability of related regulations

Activity	Regulation Number
Sailing activity	Law No 17 of 2008
Shipping company	Regulation of Minister of Transportation Number PM 65 of 2019
Ship construction and classification	PT 3 Volume VIII of 2006
Ship Measurement	Regulation of Minister of Transportation Number PM 45 of 2021
Ship registration	Regulation of Minister of Transportation Number PM 39 of 2017
Special ship operation permit	Regulation of Minister of Transportation Number PM 3 of 2015

to the level of facilities provided. Ship capacity is a key consideration for operators when setting tariffs to cover operational costs; the more passengers transported, the cheaper the fare will be.

A feasibility analysis of the legal aspect is carried out to assess the conformity between the ship's specifications and applicable regulations related to the construction and operation of Airfish 8. For a ship to operate, it must meet the construction requirements based on the ship classification, which are generally regulated by the IMO, after which each classification body can make construction rules and their respective classifications. Each ship owner can choose a different classification bureau. The Airfish 8, as the object of research, has been classified by the Lloyd's Register (LR). If operated in another country, the ship owner can use a dual-class arrangement to adjust to regulations in other countries, for example, by adding the Indonesian Classification Bureau (BKI). A comparison of suitability between ship classes and dual-class scenarios can be seen in Table 4.

In actual conditions, Airfish 8 is built and operated in Singapore and Malaysia with a single-class classification from Lloyd's Register. From the comparison, LR has adapted the chapter structure in accordance with IMO regulations, while BKI has modified the structure by merging and separating several sections in order to focus the discussion on certain structures. Conformity between the classification rules allows the construction of sister ships even with different flags. In general, although there are differences in the regulatory structure, these two classification rules are still compatible with each other. Shipowners have several alternatives, namely continuing to operate with a single class or a double class, but the consequences of each alternative for administrative costs need to be considered. Operation with a single class must first begin with the administration of changing the flag to Indonesian, as this is an obligation because cabotage applies in Indonesia [39]. On the other hand, the operation of ships with a double class will increase annual administrative costs because fees must be paid to two ship

Table 6. Availability of basic and supporting facilities

Operation	Availability	
	Yes	No
Port facility (wharf)		
- Labuan Bajo	√	
- Padar Island	√	
- Rinca Island	√	
- Komodo Island	√	
- Pink beach	√	
- Manta dive point		x
- Kanawa Island	√	
Communication and navigation		
- Navigation radio	√	
- Cellular phone	√	
- AIS	√	
- Navigation sign	√	
- Weather report	√	
Ship maintenance		
- Shipyard		x
- Workshop		x
- Fuel bunker	√	

classification agencies. Another indicator of the feasibility of legal aspects is the availability of regulations for the operation of WIGE craft in Indonesia. In accordance with IMO regulations, globally, WIGE craft are categorized as ships and are subject to shipping regulations. The identification of regulatory availability can be seen in Table 5.

The operational feasibility indicator is the suitability of the WIGE craft to operate in a particular area. The analysis was carried out by identifying the availability of basic and supporting facilities at KNP in Labuan Bajo (Table 6).

The results of the analysis show that, from the aspect of port facilities, almost all entry points of tourist destinations in KNP have supported the berthing of WIGE 8. The available port facility is a floating wharf, which is an extension of the port pier. This floating wharf construction makes it easy for the WIGE 8 to be moored because the height of the wharf is almost parallel to the height of the access door. The available mooring facilities are also in the form of steel and wooden poles that are firmly anchored so that they are able to withstand the weight of the ship. At the Manta Dive Point, there are no port facilities because it is in the middle of the sea; snorkeling and diving activities can be done directly from the WIGE 8 access door, after which tourists swim with the current for a certain distance. In this area, ships are not allowed to carry out anchoring activities so as not to damage the coral ecosystem. Therefore, WIGE 8 will turn off the ship's engine and drift with the ocean currents.

Communication and navigation are factors that must be met by operators and regulators in the shipping sector because they are related to shipping safety. There are communication and navigation facilities of a general nature, such as cellular telecommunications, and some that are mandatory to be provided by the regulator, such as radio navigation stations. Shipping navigation in the KNP area is under the work area of the Class II Directorate of Navigation in Kupang. Although currently there is no coastal radio station in Labuan Bajo, the need for radio communication between ships and the port is still fulfilled through radio communication on Channel 16 frequency 156.8 MHz. WIGE craft are equipped with AIS so that their position and movement can be monitored in real time. The weather is a very influential factor on the day of the ship's operation. The Harbormaster of the port of Labuan Bajo, as a regulator, receives actual and continuous daily weather information from BMKG so that it can be used as the basis for giving sailing permits to all ships operating in the waters under its jurisdiction.

In order for the ship to operate in good condition at all times, repair, maintenance, and supply activities are needed. Repair and maintenance activities involve the addition of certain components on ships, such

as fuel and spare parts. The availability of shipyards around the ship's operating area is very important because it is related to planning effective operating days. If there is a shipyard or workshop around the home base port, repair and maintenance activities can be scheduled more easily without reducing the effective days of operation. For repair and maintenance activities, WIGE craft are relatively easy to handle, because they can be carried out in small shipyards as long as there are workshops and facilities for fiberglass and machinery work. Based on the identification of shipyard availability, it is known that around Labuan Bajo there is currently no shipyard. Therefore, for repairs and maintenance, mobilization must be carried out to shipyards located in Bima Regency, about 73 NM from the Labuan Bajo port home base. In an emergency condition, floating repairs can be carried out if there is minor damage related to machinery. However, these should be carried out at the Port of Labuan Bajo so as not to cause environmental pollution impacts such as oil spills. The need for fuel supply is quite easy to fulfill, because at the Port of Labuan Bajo, refueling services are available.

Scheduling feasibility is an assessment of the feasibility of a business unit to operate within a certain target timeframe. In this study, the WIGE 8 scenario was able to achieve the target of operating time within a period of 3 years. The analysis carried out is the identification of stakeholder needs, which is focused on the investor's perspective. In practice, investors will interact with other stakeholders such as regulators and suppliers. The output of the interaction is then compiled in the form of a roadmap for preparation and implementation with a target time of 3 years shown in Table 7.

The results of the analysis show that the operational implementation target can be achieved within three years from program initiation. Based on the activity period, it can be identified that the startup time, starting from market research and additional administrative activities at the local level, takes a considerable amount of time, approximately 2.5 years, where the largest time allocation is shipbuilding. Other activities individually require a fairly short time, ranging between 1-2 months, but cumulatively, they also require a long duration because of the sequential nature of the process, in which the fulfillment of eligibility for one component is a requirement to carry out the next stage. This is usually a legally binding requirement. From an investor's perspective, the longer time required for the startup phase is a disadvantage because the initial financing will continue to increase, but the achievement of the shipping operational target in the middle of the third year provides a positive indication that the roadmap can proceed as planned. The existence of an alternative to improve time efficiency will have an impact on the effectiveness of financing, namely by reducing startup time with substitution activities that provide the same output. Purchase of used ship units with technical specifications in accordance with market research and with construction proven to be seaworthy can replace the activities of building new ship units. This substitution eliminates activities from basic design to design approval, so that cumulatively it will cut startup time by almost two years.

Table 7. Business scenario of WIGE Craft in Labuan Bajo

Activity	Initial Year												Year +1					Year +2																
	1	2	3	4	5	6	7	8	9	10	11	12	1 to 12	1	2	3	4	5	6	7	8	9	10	11	12									
Market research																																		
Basic design																																		
Model test																																		
Keyplan design																																		
Design approval																																		
Ship construction																																		
Sea trial																																		
Inclining test																																		
Ship measurement																																		
Ship registration																																		
Special ship operation permit																																		
Administration in local area																																		
Operational phase																																		

4. Conclusion

The transportation sector, as a supporter of tourism, requires planning because there is significant investment involved, which is expected to provide added value to the relevant stakeholders. An initial assessment of its feasibility is required as consideration to decide on the sustainability of the investment. Based on the analysis, it can be concluded that in general, the Airfish 8 WIGE craft is feasible to operate in Labuan Bajo because it meets almost all the requirements from the technical aspect, with operational capability of over 70% sailing days per year according to sea conditions. Economically, it meets the financial feasibility indicators and also meets legal requirements. In general, WIGE operations can be carried out with the support of adequate facilities. Investors can accelerate the transition to the operational stage by reducing startup time. Regulators can support shipping safety by paying attention to the availability of navigational aids and allocating repair areas in the Port of Labuan Bajo. The industrial business sector can also provide added value by building shipyards around Labuan Bajo. For further research, it is possible to evaluate the business feasibility of investing in other types of WIGE craft or seaplane operations, as well as passenger tariff purchasing power.

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