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ANALYSIS OF THE LEVEL OF INNOVATION AND TECHNOLOGY READINESS IN THE POND WATERWHEEL TECHNOLOGY DEVELOPMENT PROJECT TO SUPPORT INCREASED NATIONAL SHRIMP PRODUCTION (CASE STUDY OF PT. BARATA INDONESIA PERSERO)

The local and international market demand for shrimp has not decreased during the Covid 19 pandemic. This is an opportunity for the Indonesian people to cultivate shrimp that meets consumer needs. To support shrimp production, PT. Barata Indonesia produces waterwheels which are expected to support national shrimp production. The need for waterwheels is assessed before being sold commercially by consumers. The assessment is a tool to measure the readiness level of technological innovation called KATSINOV and calculates the Technology Applied Readiness Level. This research uses Katsinov-Meter software. Katsinov-Meter is software that collects 7 main aspects in which there are standard statements for each Katsinov level. There are 6 Levels of Innovation Readiness (KATSINOV), namely concept, component, completion, gap, competition, and moving or quitting. Measurement of KATSINOV and TKT was carried out with the aim that these tools can be prepared before being commercialized and can be developed in the future. One of the innovative concepts for waterwheels is having DO (Dissolved Oxygen). This DO sensor is used to detect dissolved oxygen levels in water. In this study, the waterwheel product produced by PT Barata Indonesia (Persero) is included in the Katsinov 3 and TKT 7 categories. This means that the waterwheel product deserves to be called a new innovation.

Keywords: Waterwheel, Technology, Innovation, Barata

1. INTRODUCTION

Indonesia is a rich country in shrimp production levels in Southeast Asia. So that it has a very profitable business opportunity. In the fisheries sector, shrimp pond business was one of the business opportunities that has positive prospects both in the domestic and international markets.

It was proven that during the Covid 19 pandemic, domestic and international market demand does not decreased. The demands of economic conditions during the current Covid-19 pandemic in Indonesia, placing the position of industries that use a labor-intensive system on the brink, so that production continues in order to maintain business continuity [15].

In addition, in shrimp cultivation, it has now begun to develop, started from make ponds at sea and in lakes, cultivating through freshwater ponds only used artificial ponds made of tarpaulin. This aims was for increased shrimp productivity in ordered met market demand. To support this, it was necessary to made technological innovations made by the nation's children to support the increase in national shrimp production, so domestic-made waterwheels and water pumps are innovated. It is enhanced by a continuous improvement system based on findings or issues raised related to product design [14].

One of the innovative concepts for the waterwheel was for has DO (Dissolved Oxygen). This DO sensor serves to detect the level of oxygen dissolved in water. In addition, this innovation has a higher Coverage Area, was energy efficient, easy to maintain and easy to obtain spare parts. The planning of this waterwheel starts from the engineering stage, supply chain, production to marketing. Continuous improvement is very effective to increase competitive advantage [17].

To support the achievement of the target of increasing national aquaculture, it will take around 1.5 million units of waterwheels until 2024. Example of changes could be the pandemic situation we are currently experiencing, shift in trends related with aquaculture products consumption, emerging aquaculture technologies and increasing competition in the sector both nationally and globally [10].

PT. Barata Indonesia Persero is developing energy-efficient waterwheel technology from local materials in collaboration with the Sidoarjo POLTEK KP and the Research Agency of the Coordinating Ministry for Marves and the Ministry of Marine Affairs and Fisheries (KKP). As a BUMN Manufacture, PT. Barata Indonesia is committed to increasing the level of domestic components (TKDN) in each of the National strategic projects as well as the manufactured products. Assessment based on data collection and relevant efforts that should be created to fix the problem [5]. In the manufacturing world, of course, customer satisfaction with the output produced is the main thing that is maintained [4].

According to the regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 29 of 2019 concerning Measurement and Determination of Innovation Readiness Levels in article 1 (one), it is explained that innovation was a research, development and / or form of engineering activity that aims to develop practical application of value and scientific context. new knowledge or new ways to apply existing science and technology to a product or production process. The measurement and determination of KATSINOV is carried out by observed the status condition of the level of technology application readiness as a prerequisite that must be met by an innovation product so that it is ready to enter the market and survive sustainably. Article 8 paragraph 1 states that the measurement and determination of KATSINOV for an innovation product was carried out at the level of KATSINOV 3 to KATSINOV 4. Furthermore, in Article 8 paragraph 2 states the measurement and determination of KATSINOV as referred to in paragraph 1 shall be carried out with the condition that it reached the most readiness level for the application of technology. low was level 7 (TKT 7). With this energy-efficient waterwheel, it is hoped that it can overcome the problems that exist in pond farmers in terms of reducing business capital related to pond operational costs and the ease of maintenance of the waterwheel.

2. METHODS

This research used Katsinov-Meter software. Innovation readiness level known as Katsinov is a method that could estimate innovation readiness from an innovation program both companies, research and development institutions and universities which could be seen from several aspects, such as technology, market, organization, partnership, manufacture, risk and investment [2]. Katsinov-Meter was a software that collected 7 key aspects in which there were standard statements for each Katsinov level. There were 6 Innovation Readiness Levels (KATSINOV), namely concepts, components, completion, chasm, competition, and moving or quitting. The 6 levels of Katsinov can be seen in Table 2.1.

Table 2.1: Level of Readiness for Innovation (Katsinov)

KATSINOV		EXPLANATION
6	Change-over or close-down	The market decline stage, and the determination of two options, namely moving (change-over) with re-innovating technology, or stopping (close-down) by seeing the innovation has been outdated and deciding to exit
5	Competition	This is a phase of market maturity, when a market equilibrium is reached in the absence of significant growth or innovation.
4	Chasm	Chasm is between the early adopters (the enthusiasts & visionaries) and the early majority (the pragmatists). The initial stage of introducing the results of the innovation to the market has been carried out. At this stage there are challenges and difficulties whether the innovative product meets the needs or demands of the customer when it is first introduced to the market.
3	Completion	The technology development has been completed and all system functions

		have been proven in the field.
2	Component	Components have been developed and validated, and prototypes have been developed demonstrating the technology.
1	Concept	The basic scientific principles of innovation have been observed and reported, and their critical functioning and / or characteristics have been confirmed experimentally

Source : Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 29 of 2019 concerning Measurement and Determination of Innovation Readiness Levels.

Katsinov's assessment was carried out by collecting data, information and facts from the object of research. Katsinov measurement flow chart can be seen in Figure 2.1.

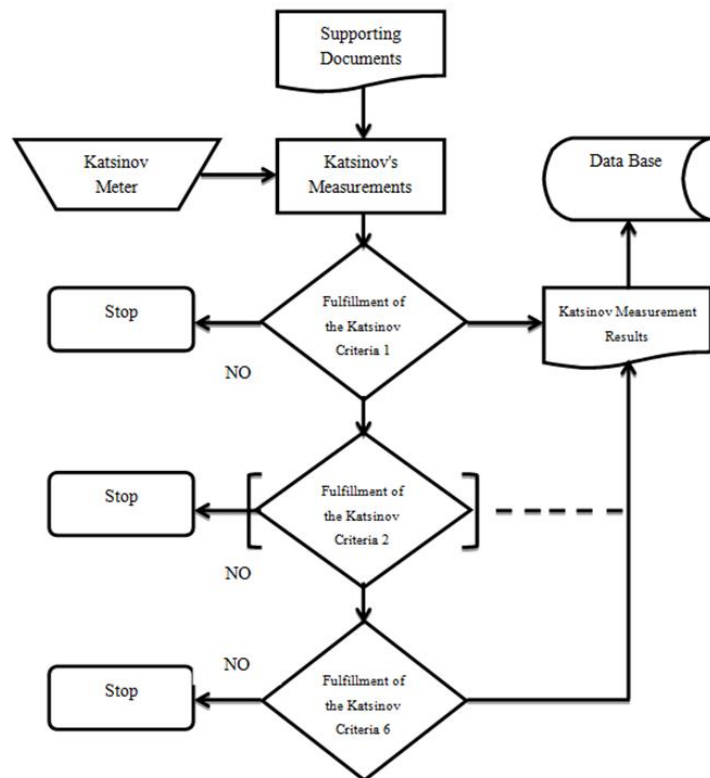


Figure 2.1: Katsinov Measurement Flowchart

Furthermore, from the results of the KATSINOV calculation, the Technology Readiness Level (TKT) was determined. A technology that has been researched needs to be assessed for its technological readiness from the results of its technological design. Technology readiness according to regulations [8] is the level of maturity condition or readiness of a technology research and development result that is measured systematically so that it can be adopted by users, both by government, industry and society [6], [7], [18]. In this case study, TKT includes TKT of the type of Agriculture / Fishery / Animal Husbandry where in the determination of TKT there WERE 9 (nine) definitions or status and several determining indicators.

Table 2.2: Status and Indicators of TKT Determination

NO	DEFINITION/STATUS	INDIKATORS
1	The basic principles of a technology have been studied	1) The research question formulation or research hypothesis already exists; 2) A literature study on basic principles related to research has been carried out; and 3) The method / method / process / product researched and will

		be developed already exists and has a chance of success
2	Technology concepts and applications have been formulated	<ul style="list-style-type: none"> 1) The facilities and infrastructure to be used have been identified; 2) The validation of the results of the literature study is carried out; and 3) The theoretical and empirical research designs have been identified
3	Important concepts and characteristics of a technology have been proven analytically and experimentally	<ul style="list-style-type: none"> 1) The research design has been prepared (preferred methodology, stages, and data required for research); 2) Theoretically, empirically and experimentally have been known and the components of the technology system can work well; and 3) Technology is scientifically feasible (analytic studies, models / simulations, experiments).
4	The technological components have been validated in a laboratory environment	<ul style="list-style-type: none"> 1) Separate component laboratory tests have been carried out; 2) The performance of each technology component (method / method / process / product) to be developed has shown good results; 3) Experiments on the main functions of technology in the relevant environment have been carried out; 4) Laboratory scale technology prototypes have been made; 5) Component integration research has started; 6) Preliminary analysis shows that the required main function can work properly. 7) The integration of technology components and laboratory-scale design has been tested (low fidelity).
5	The technological components have been validated in the relevant environment	<ul style="list-style-type: none"> 1) The technology prototype is ready to be tested in modified laboratory conditions that are closer to the real environment; 2) Accuracy / fidelity increases; 3) The integration of technology components have been tested with high accuracy (high fidelity).
6	The model or prototype has been tested in the relevant environment	<ul style="list-style-type: none"> 1) The requirements for a technology are known (at optimal conditions); 2) The technology has been tested with high accuracy in simulated operational environments with complete data (according to the design or research design); 3) The test results prove technically feasible (engineering feasibility); and 4) Draft analyst
7	The prototype has been tested in a real environment	<ul style="list-style-type: none"> 1) The actual / operational environmental conditions for technology are known; 2) Field scale technology multi-location testing has been carried out; 3) Field test results show stable performance / performance; 4) Multi-location test results prove technologically feasible. 5) The identified investment needs for the production process; and 6) Complete economic feasibility analysis (validation result in actual environment).

8	Technology system is complete and qualified	1) The prototype and detail engineering drawings of the supporting equipment are available; 2) The cultivation process with the desired productivity level has been mastered; 3) Technology standardization has been carried out; and 4) All materials and equipment for use in production are available.
9	2Technology is tested / proven through successful operation	1) The concept of applying technology is completely applicable; 2) Estimates of technology investment have been made; 3) No significant design changes; 4) The technology has been tested in the actual environment; 5) Has fulfilled the required certification; and 6) All documentation is complete.

Source : Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 42 of 2016 concerning Measurement and Determination of Technology Readiness Levels.

3. RESULTS AND DISCUSSION

The stages of the process of implementing the KATSINOV Self-Assessment and the Level of the Waterwheel Technology of PT. Barata Indonesia (Persero) starting from preparation to reporting are as follows.

3.1 Site Survey

At this stage a location survey is carried out which coincided with the PT Barata Indonesia (Persero) workshop in Gresik, East Java. This activity is accomplished to review the readiness and see the factory capacity of PT Barata Indonesia (Persero). In the production process, PT Barata Indonesia (Persero) involved 3 workshops including an Agro Industry Workshop, a Heavy Industry Workshop and a Machining Center Workshop.

Activities carried out at the PT Barata Indonesia (Persero) Workshop include Fit up, Welding, Assembly, Marking, Cutting and Drilling. The flow of the production process includes frames produced by PT Barata Indonesia (Persero) which previously carried out the marking and cutting processes. Before welding, there will be an inspection / Quality Control. The QC flow starts from the randomly selected raw material, then it will be visually checked for defects or not as well as dimensionally based on the conformity specified on the Mill Certificate.

3.2 Waterwheel Design

Furthermore, a design presentation by PT Barata Indonesia (Persero) was carried out at the PT Barata Indonesia (Persero) Workshop. From the results of the exposure, the pond waterwheel produced by PT Barata Indonesia has the following specifications:

1. The main drive is an electric motor with a power of 0.5 HP / 370 WATT with a transmission system using gears and chains that can reduce 1400 RPM rotation to 100 RPM.
2. The main frame of the windmill is made with galvalume iron base and the main shaft uses a 3/4" iron pipe.
3. Bearing the gear shaft and chain on the waterwheel mounted pillow block to support the performance of the shaft in order to reduce resistance.

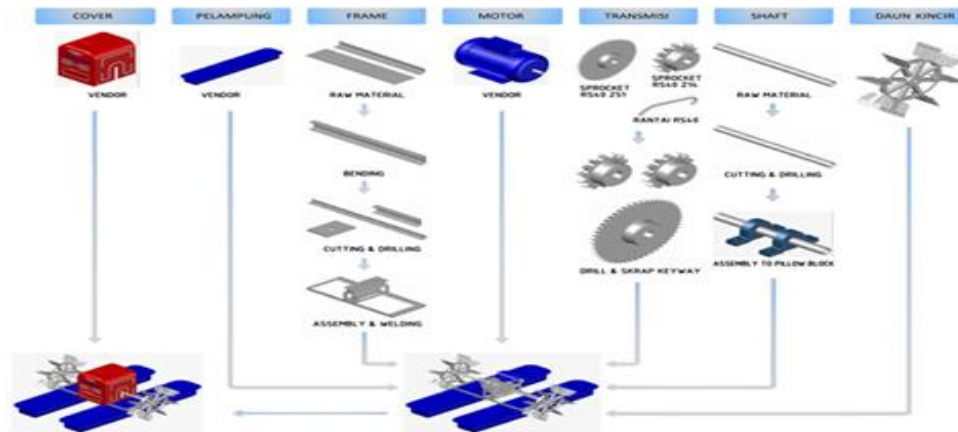


Figure 3.2.1: Waterwheel Design

Meanwhile, the waterwheel product uses a 20" bicycle wheel, while the leaf wheel is made using a 4" paralon pipe which is molded according to needs and mounted on the wheel wheel. After all the components are installed, then try the initial stage of testing, which is to check the rotation of the shaft and the blade of the mill whether it is in accordance with the established standards and check whether the electrical installation section is safe in accordance with the SOP. Furthermore, the components of all assembled waterwheels are placed on floats made of 6" paralon pipes. To avoid the electric motor from being exposed to water, a cover is made and then stage 2 testing is carried out by placing the waterwheel machine on top of the pond media by measuring the height of the Splash of Water, the Dissolve Oxygen produced and the Coverage Area.

The waterwheel design is a waterwheel concept using materials produced in the country. It is intended that the waterwheel is easy to maintain and replace spare parts. The design of the waterwheel can be a competitive advantage for PT. Barata Indonesia in the production of waterwheels.

3.3 Waterwheel Prototype Test

At this stage, a prototype test is implemented at the Polytechnic of Marine and Fisheries, Sidoarjo.



Figure 3.3.1: Documentation of Prototype Test in Polytechnic of Marine and Fisheries

The parameters generated from the prototype test, namely the Waterwheel that is produced have the following advantages:

1. Current DO is higher than existing DO
2. Current coverage area is higher than existing coverage area
3. Save energy
4. Easy Maintenance

5. Spare parts are easy to get

3.4 Katsinov Self-Assessment & Readiness Level for Waterwheel Technology Application

Based on the parameter indicators from KATSINOV 3, the Self Assessment is obtained as follows:

1. The Waterwheel Innovation produced by PT Barata Indonesia (Persero) is a new idea that provides a solution to the problems currently faced by pond farmers in terms of reducing business capital related to pond operational costs and ease of waterwheel maintenance.
2. The Waterwheel produced by PT Barata Indonesia is an actual technology system that has been demonstrated by the Sidoarjo KKP Poltek and observations have been made regarding basic scientific principles and scientific publications.
3. The product has been tested externally from the technology that has been developed and has met the technical requirements and regulatory compliance.
4. The waterwheel product has been documented based on the developed technology.
5. The waterwheel has so far known the need and the segment, size and market share have been predicted.
6. By design the system is mostly stable and has been proven in tests and evaluations.
7. The waterwheel product is a manufacturing process and procedure on a pilot project scale, meaning that the mill product produced by PT. Barata Indonesia (Persero) is expected to replace the waterwheel which has been imported.
8. During the engineering period, from production to sales, formal partnerships have been established and have implemented cooperation with companies that have competence in Indonesia.

Based on the parameter indicators of Technology Readiness Level 7, the Self Assessment is obtained as follows:

1. Waterwheel PT. Barata Indonesia (Persero) is included in the TKT type of agriculture/animal husbandry with indicators of the basic principles of a technology that has been researched. Starting from research formulations/hypotheses, literature studies on basic principles related to previous research, researched and developed methods/processes/products already exist and have a chance of success.
2. The waterwheel has been validated in a laboratory environment, namely laboratory tests of the components separately have been carried out. Reviewing the performance of each component of the waterwheel both in terms of methods/processes/products developed has shown good results.
3. Experiments of the main function of waterwheel technology in the actual environment have been carried out.
4. A laboratory-scale technology prototype has been created.
5. Preliminary analysis shows that the required waterwheel technology can work well.
6. The waterwheel has been tested on a multi-location field scale, from these results it shows that the waterwheel's performance is stable so that the waterwheel technology proves that it is feasible to operate and the investment needs for the waterwheel production process have been identified.

4. CONCLUSION

Pond waterwheels produced by the company PT. Barata Indonesia Persero is a waterwheel originally made by the local people which aims to increase the productivity of aquaculture ponds in Indonesia. The waterwheel starts from the design stage of the waterwheel and the waterwheel prototype test. After the self-assessment is carried out, the level of innovation readiness (KATSINOV) and the TKT of the pond waterwheels were in Katsinov 3 and TKT 7. The results of the waterwheel prototype test showed the advantages of PT. Barata Indonesia Persero, namely higher Dissolved Oxygen, wider coverage of the waterwheel area, energy-efficient waterwheels, easy maintenance and waterwheel spare parts are easy to obtain because waterwheel spare parts are made in the country.

Based on TKT indicators, PT. Barata Indonesia (Persero) is included in TKT 7 types of agriculture / livestock with the following indicators:

1. The basic principles of a technology have been researched.
2. The waterwheel starts from the preparation of a research / hypothesis formulation
3. A literature study has been carried out on the basic principles associated with previous research

4. Researched and developed methods / processes / products already exist and have a chance of success
5. The waterwheel has been validated in a laboratory environment by carrying out laboratory tests of the components separately.
6. Judging from the performance of each component of the waterwheel both the method / process / product developed has shown good results.

From the results of the self-assessment of the waterwheel products of PT. Barata Indonesia (Persero), the authors recommend the following:

1. To achieve Katsinov 4 The author suggests that the product needs to be built on the image of technology products to the market (consumers) by identifying competitors critically and a marketing system that focuses on product introduction specifically to consumers is needed.
2. To achieve TKT 8 the authors suggest that waterwheels should apply quality assurance according to standards (SNI) by considering the safety and security of the products used.
3. To achieve Katsinov 4 The author suggests that a social impact risk assessment should be carried out at the stage of introducing waterwheel products to the market (consumers).
4. To achieve TKT 8 the author suggests that PT. Barata Indonesia needs to provide / produce spare parts supply for waterwheel products after mass marketing is carried out.
5. The author recommends that to achieve KATSINOV 4, it is necessary to identify competitors well, a marketing system that emphasizes the introduction of specific products and technology to consumers.
6. Please improve the KATSINOV 3 indicator regarding intellectual property rights (for example: patents, industrial designs, copyrights, brands, etc.).

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