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Study of Supply Chain Management of Industrial Plan Manufacturing Development of Marine Power Turbine in Indonesia

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STUDY OF SUPPLY CHAIN MANAGEMENT OF INDUSTRIAL PLAN MANUFACTURING DEVELOPMENT OF MARINE POWER TURBINE IN INDONESIA

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Abstract. Indonesia had announced its target to reduce carbon emission by achieving 0% Net Zero Emission (NZE) by 2060. So starting in 2022, the Government must update the regulations governing the energy sector to encourage the implementation of renewable energy. As an archipelagic country, one of the renewable energy potentials is Ocean Renewable Energy (ORE). The contribution of the ORE to Indonesia's National Energy Mix is almost none. Thus, it is a good chance for the government to give more incentives for implementing ORE, especially in eastern Indonesia where they are abundantly available. Since the infrastructure and supporting facilities there, including industries, are sparse and the supply chain management depends on Java Island, it needs special regulations to speed up the implementation of ORE. This paper studies the supply chain management of the implementation of marine current turbines base on secondary data and the experience of engineers from the National Research and Innovation Agency when they implemented the converter technology of the marine current turbine at Larantuka Strait, Nusa Tenggara Timur. Results In this study, the implementation of ocean current turbines must be integrated with government policies related to maritime connectivity and security because the energy produced is large enough and suitable for execution.

1. Introduction

One of the 3 (three) issues that must be followed up in the G20 Presidency is the transition to sustainable energy. Indonesia has committed to achieving the target of 0% gas emission (Net Zero Emission / NZE) in 2060. This target is very difficult to achieve so from now on we must work hard to carry out real efforts to achieve this target, while the target soon is to mix new renewable energy sources in 2025 of 23% is very difficult to achieve. The only solution is that we must have the courage to immediately switch to renewable energy sources. Another effort is the Government's commitment to gradually reduce the number of Diesel Powered Electric Companies (PLTD) which currently number around 1700 units spread throughout Indonesia to be replaced with power plants from renewable energy (low emission) sources.

The source of renewable energy in Indonesia is very large if it can be utilized optimally. Potential sources of renewable energy from solar, geothermal, water, wind, and sea are available in Indonesia. The table below shows the potential sources of renewable energy that can be utilized:

Table 1. Potential sources of new renewable energy [1].

Energy sources	Potential (GW)	Utilization (MW)
Solar	3,295	217
Bioenergy	95	6,637
Wind	155	154
Bioenergy	57	2,284
Geothermal	24	2,293
Marine	60	0
Total	3.686	11,585

According to [2], We suffer from the lack of discussion about our energy planning in the future Especiallcy as an archipelago country we have no plan of our potential of renewable energy source from sea,.So it is still not fully utilized (0 MW) as shown in Table 1. This phenomenon is very concerning and needs to be immediately found a solution. [2] Also stated that energy security' requires the availability of sufficient quantity of energy resource at affordable prices, implicating protection of the entire supply chain component and the infrastructure. In fact, our energy price are become higher from day to day like what we are experiencing right now.

Government needs to immediately evaluate the existing policies so that the government starts paying more attention to renewable energy from sea. The advantages of renewable energy from sea includes:

1. It has a large energy density (ρ) at low current speeds ($\rho_{water} = 830\ \rho_{air}$).
2. It can be estimated theoretically
3. No need for "Over-engineering" like other sources.
4. Smooth / not noisy.
5. Always Renewable and sustainable.

The energy potential of ocean currents is mostly found at the Eastern Indonesia [3], as shown in the figure below :

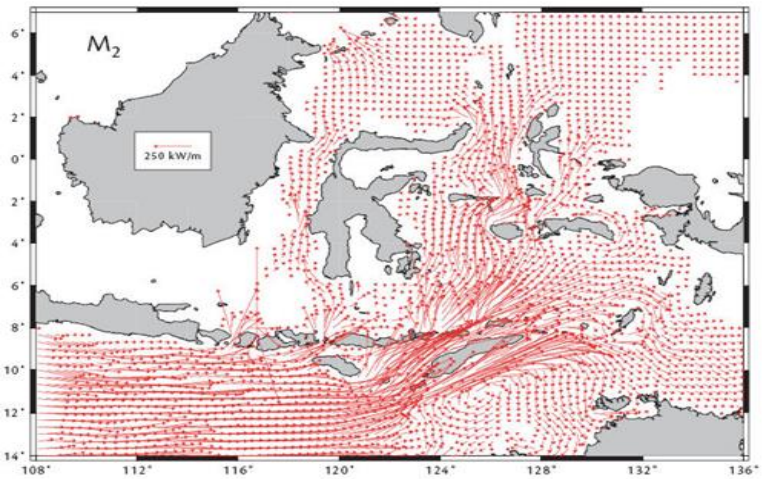

Figure 1. Potential ocean currents in eastern Indonesia

Based on this potential (Figure 1), most of the research was carried out in the Eastern Indonesia region. Ai Yuningsih et al from P3GL-ESDM [4] have studied the potential of ocean currents in Larantuka Strait, East Nusa Tenggara which explained that the potential source of ocean current energy in Larantuka Strait, NTT is very potential to be used as a source of electricity generation. This

supports the research report carried out by Erwandi et al from BRIN [5], which has initiated several measurements in Larantuka Strait - NTT area about the energy potential of ocean currents in the same location as a potential location for the installation of Ocean Current Turbine.Meanwhile, Yulhendri from the Center for the Study and Engineering of Marine and Fisheries Technology [6] conducted studies at different locations at western part of Indonesia, namely the Riau Archipelago. The results of the study explain that Sugi Island is the most suitable area for the implementation of ocean current power plants. Other data regarding the study of the potential for ocean current power plant (PLTAL) following table 2:

Table 2. Potential ocean currents in a number of straits [7]

No	Area	Max tidal speed	Resource Density	Width of potential area (Width above 1,5 ms in sqm)	Theoritical resource (MW)	Tehnical resource (MW)	Practical Reource (MW)
1	Riau Strait	1,39	1,38	55,751,111	96,432	24,108	6,027
2	Sunda Strait	2,63	9,32	21,025,000	36,367	9,092	2,27
3	Toyopakeh-Bali	3	13,84	2,959,360	5,189	1,280	320
4	Lombok-NTB	3	13,84	2,959,360	33,049	8,262	2,066
5	Alas Strait-NTT	2,9	12,5	60,853,994	105,258	26,315	6,579
6	Larantuka-NTT	3	13,84	287,500	497	124	31
7	Pantar Strait-NTT	2,91	12,63	921,600	1,594	399	100
8	Boleng Strait-NTT	1,5	1,73	1,658,610	2,868	717	179
9	Molo Strait-NTT	1,85	3,24	216,400	374	93	23
10	Mansuar-West Papua	1,79	2,94	3,619,998	6,261	1,565	392
Total					287,889	71,955	17,990

Cooperation activities for the implementation of the study of potential for ocean currents have also been carried out as follows:

1. Cooperation Project for the construction of the Pancasila Bridge in Larantuka - NTT between Indonesia (PLN - the Netherlands), to plan the construction of a bridge connecting Larantuka - Adonara Island, NTT, where the lower side of the Bridge column is installed with a sea current turbine. The total capacity of the turbine is 40 MW, with an energy of 100 GWh/year.
2. The potential development project for tidal power plants (UK Cooperation and PT.Pertamina Indonesia Power) with a turbine capacity of 100 KW per Turbine.
3. Study of potential ocean currents in Lombok Strait and Sape Strait, as a research collaboration between Indonesia and France (2016-201),
4. MOU on the cooperation plan between P3GL ESDM and Andritz Hydro, in the development of ocean currents in Indonesia, (2014).
5. MOU between PT.SBS and PT.PLN (Persero) in the PLTAL development plan in the Maluku region (2015).
6. Development cooperation between PT. PAL (Indonesia) and PT. PLN (Persero) in the construction of marine energy turbines as a major industry commitment to the construction of marine turbines.

From the opportunities above, we should start opening up more opportunities in the turbine industry from the sea through a series of supply chains.

The purpose of the paper is to conduct an initial study of the extent of the supply chain of the marine renewable energy industry through the collection of secondary data on the state of industrial readiness, political support from the Government and other support from related industries (supporting component industries, banking and transportation industries

2. Supply Chain Management

Supply Chain Management is the process of planning, designing, and controlling the flow of information and materials along the supply chain in satisfying consumer demands now or in the future in an efficient and effective way [8]. Supply chain management (SCM) is an important business strategy, particularly in the manufacturing process. SCM assists the company to control its products and understand consumer needs.

According to [9] Supply Chain Management (SCM) is an optimization management of a supply chain operation. Implementation of Management is carried out by a (Manager) to optimize existing resources in a supply chain. A supply chain manager is tasked with identifying critical resource conditions in a supply chain, identifying potential strengths and influencing resource performance and can utilize a number of information to develop goals, objectives, and optimize supply chain flow. SCM managers can view the future as an opportunity.

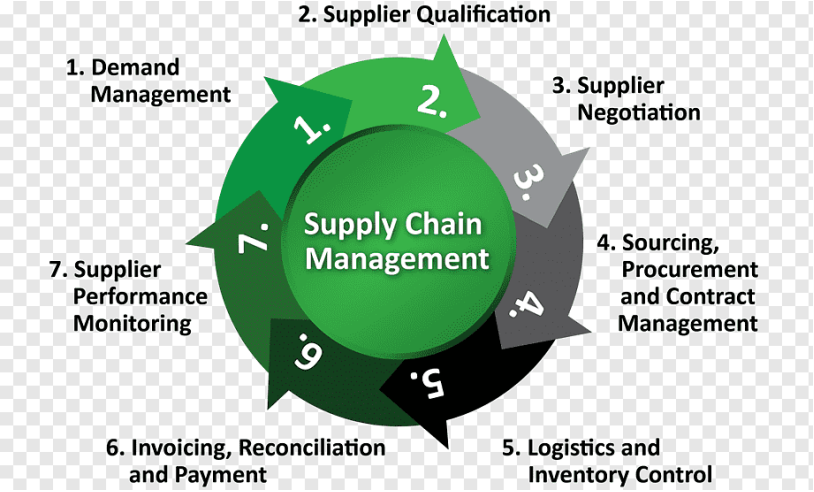

Figure 2. Supply Chain Management [10]

From Figure 2 above, SCM activities include all supporting components to form activities that can guarantee a product is easy to get, affordable prices and sustainable production through a series of collaborations all related components.

3. Methodology

The method of writing is in the form of secondary data collection on the potential capabilities of domestic industries as well as Government support in the marine new renewable energy sector in forming industrial supply chains to increase the utilization of local content (TKDN).

4. Literature review

As stated in introduction, another reason in Indonesia energy's problem is the Government's failure in energy policy due to the policy error of the National energy subsidy program. Energy subsidies lead to an increase in dependence on fossil energy consumption, it is not encouraging people

to reduce fossil energy consumption and switch to environmentally friendly energy consumption. Energy subsidies lead to a reduction in budgetary subsidies for Health, Education and an increase in corruption, poverty, and income inequality.[11]. To solve these problems, the Government is determined to carry out energy reforms through a transitional policy of achieving the 0% Net Zero Emission (NZE) target of carbon gas emissions by 2060 as mandated in the Kyoto Protocol and Paris Agreement, calmly agreeing on a solution to the threat of climate change and maintaining an increase in climate change. global temperature below 15 degrees [11].

Renewable energy sources are expected to be a solution to be able to contribute to the reduction of air pollution and dependence on fossil energy sources. In this case, cooperation between the Government, researchers/universities, and the private sector (triple helix) is urgently needed to immediately find a solution in generating findings of renewable energy sources to reduce the threats mentioned above so that the target of increasing the contribution of the NRE mix from 19% in 2017 to 65% in 2050 can be achieved [12].

To save energy consumption one of its efforts is the use of renewable energy. However, there are still obstacles to its utilization, such as geographical constraints of the location of the source of renewable energy, distribution or delivery of renewable energy products, imbalances in the scale of economy in each region, and government policies that are not balanced in the application of subsidies and taxes on renewable energy products. The application of the renewable energy supply chain is one solution. The implementation of good supply chain management will result in more affordable and competitive renewable energy prices. Off course the obstacle is that in the early stages, namely the renewable energy industry's initial investment cost will be more expensive than the fossil energy industry. But in the long term, the renewable energy industry will produce more economical and profitable product prices. Production costs will decrease in the long run. This is due to the excess of renewable energy resources which is always renewable and will never run out. Long-term production efficiency will be used to cover investment costs and production cost savings. Therefore, renewable energy sources will be a solution to the problem of global energy consumption and overcome the effects of environmental impacts (air pollution) [13].

The application of supply chain management can also be applied to industrial concepts that convert waste into renewable energy sources (Waste to Energy/WTE). The WTE concept is also known as the circular economy concept 5R (Reuse, Recycling, Reduction, Repurpose and Recovery) which is proven to be able to create profit from something that was previously waste production. This shows that the implementation of good supply chain management in every industry will provide benefits [12].

According to [14], the supply chain is a network of companies that work together to create and deliver a product into hands of end users. Supply Chain Management is an integrated method between the parties involved either directly or indirectly in producing products or services. Where it starts in the process of getting raw materials from suppliers, goes to the production process, and ends in the delivery process to end users based on the spirit of collaboration to realize a common goal, namely customer satisfaction. The supply chain system can be guaranteed over [15]:

- Economical price guarantee
- Guarantee the continuity of material supply in the production process
- Guarantee the quality of production goods
- Guaranteed delivery time to consumers.

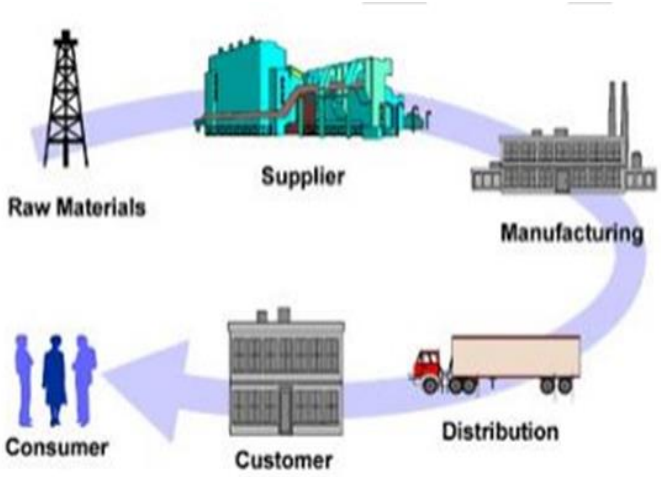

Figure 3. Supply chain process flow diagram.[16]

In supply chain management, there is a flow of material and information. Supply chain management must keep the flow of materials flowing from the source to the final consumer. In the flow of information, information technology allows demand and supply data to be obtained quickly and can increase the level of detail of a product.

Figure 3. above shows the flow of relationships between supporting components in the formation of industrial supply chain. Each component plays an important role in the success of the supply chain plan.

5. Experience in Testing and Potential Development of energy Resources from Sea

BRIN researchers have experience in designing, testing models, and testing prototypes of marine current turbines from a scale of 2 KW to a scale of 10 kW in Larantuka Strait-NTT and Madura Strait under the Suramadu Bridge, East Java. From field experience, the constraints of limited facilities and infrastructure outside Java in supporting the assembly and testing process at sea have become a separate obstacle starting from the loading and unloading process from ships at port, turbine assembly, and testing process at sea. Besides the limitations of repair shops, if there are components that are damaged so the component required to be repaired in Surabaya, it is also an experience in itself. The limited support for facilities and infrastructure is still a problem in the construction of ocean current turbines in the region. Figure 4. and Figure 5. show the experience during process of shipping goods from Surabaya to Larantuka,.where from Surabaya to port of larantuka transported by shipping via sea transportation, and then continued via trucking to assembling area.

Figure 4. The delivery process at the assembly site at Larantuka, Flores-NTT

Figure 5. The Process of unloading goods from port to assembly site at Larantuka, Flores-NTT

6. Support

6.1. Government support

The Central Government has tried to issue policies on the use of renewable energy resources, the problem is that supports is still not able to touch renewable energy from sea. Several incentives are needed to stimulate the industry to try the renewable energy industry from the sea. Local governments must also be more creative in seeking industrial opportunities in their respective regions that have potential marine energy sources to provide support for ease of business, funding, and other support in their respective regions. Synergies between the Central and Regional Governments also need to be maximized so that the potential of renewable energy sources in regions can be identified by central government for assistance in developing solutions.

Government through Bappenas has planned the development of renewable energy industry by optimizing the industrial supply chain sector as stated in the 2019-2024 (Indonesian Sharia economic master plan) as shown in It is mentioned about the plan to optimize the supply chain of the renewable energy industry is one of the specific strategies for developing renewable energy in Indonesia:

Tabel 3. Strategy for the formation of renewable energy industry supply chain [17]

	Strategy/Program/ Activity	Target indicators	year						Stakeholders
			2019	2020	2021	2022	2023	2024	
Strategy 1 : The occurrence of a sustainable relationship in the value chain of the renewable energy industry to produce sustainable energy									
2	Supply-Chain optimization of the renewable energy industry by strengthening energy industry partnerships	Mapping of the supply chain and demand for renewable energy as well as incentives for renewable energy industry partners							Ministry of Energy and Mineral Resources, Ministry of Finance, Energy BUMN, Renewable Energy NGO, Associations, Local Governments
	a. Renewable industry supply chain scale mapping		-	√	√	√	√	√	
	b. Mapping of renewable energy supply chain development priorities		-	√	√	√	√	√	
	c. Incentives for renewable energy industry partners to achieve sustainable energy targets		-	-	√	√	√	√	

Government Support which is through Government Regulations / Ministerial Regulations as below:

- Regulation of the Minister of Energy and Mineral Resources number 50/2017 in conjunction with Minister of Energy and Mineral Resources No. 04/2020 regarding the use of renewable energy sources for the provision of electricity
- Providing fiscal and non-fiscal incentives for renewable energy
- Ease of granting business permits in the renewable energy sector

6.2. Banking Support

In banking sector, although there have been some commitments to support funding from banks in the NRE industry. For example, BCA has disbursed a total of 4.7 trillion as of March 2021, while bank Mandiri has disbursed loans of 171 trillion as support to the government in its efforts to shift from fossil energy to renewable energy. , HSBC participates in environmental pollution programs (reducing gas emissions) through credit distribution, through the Bank's Net-zero program through credit, business actors in Indonesia are transitioning to the use of renewable energy such as geothermal, hydro, wind, and solar. but for renewable energy sector from sea , banking sector is still not too optimistic, because [18] :

- The financing of the renewable energy industry is a long-term project, so there is a mismatch in the banking program because banks want a quick fund turnover (short term).
- Most of the renewable energy industry is expensive, so banking sector are still worried about the speed of loan repayment from industry (as a customer).
- Considered to have a high level of risk. The industry must be assured of risk of failure

6.3. Industry support

Marine renewable energy is mostly located in Eastern Indonesia area, but the main industry and supporting industries are still concentrated in Java Island Region (especially East Java). Through the supply chain, all supporting components that are scattered in many places in a supply chain coordination will be coordinated.

1. Data on the number of metal industries in the NTB/NTT area : 0 (none)
2. Data on the number of shipbuilding industries in the NTB/NTT area : 1 (one)
3. Data on the number of metal industries in East Java : 39 (thirty-nine)
4. Data on the number of shipbuilding industries in East Java : 30 (Thirty)

7. Problems

From a number of opportunities above, there are a number of challenges faced in the marine energy development plan, including:

Table 4. Constraints in developing renewable energy from sea [1]

Aspect	Challenges
Technology	- Technology that is considered immature/not yet proven to operate commercial - The initial capital cost is quite high
Finance	- Difficulty in obtaining financing (high-risk projects) - The initial price of IDR/Kwh is quite high (this applies to almost the new renewable energy industry
Market	- Still not competitive compared to other new renewable energy sources - No Supply Chain yet
Regulations/Policies	- There are still no regulations that can be referred to, especially special support for the development of marine renewable energy in the Eastern part of Indonesia renewable energy - There is no clear framework for including Marine new renewable energy resources in the NDC (Nationally Determined Contribution) document
Infrastructure	- Poor network infrastructure

From table.4 it is stated that there are still a number of obstacles in the development of marine renewable energy. But there are still opportunities from a number of obstacles above, namely: In terms of technology, from the results of studies by researchers, it has been proven that Renewable energy technology from sea is feasible to be developed and realized considering the very open potential for

Indonesia as an archipelagic country. The central and regional governments have also begun to issue a number of regulations in order to provide as many opportunities as possible for interested industries to try out the Renewable energy industry. Likewise, the banking sector, as stated above, also supported and encouraged by government to provide soft loans support to the industry in renewable energy sector. The problem is only on market opportunities possibility that are still waiting for well facility and infrastructure support can be achieved to open up market opportunities through the availability / ease of use of local facilities and infrastructure.This support may be achieved by the readiness of the marine renewable turbine industry's supply chain.

8. Conclusion

From the article, it can be concluded that:

1. The supply chain of the marine renewable energy turbine industry is still not ready to be implemented due to:
   - The legal protection for government policies is still not optimal in favor of developing the renewable energy industry from the sea.
   - The existence of the marine renewable energy industry in the Eastern part of Indonesia renewable energy area still does not exist, (turbine manufacturing industry and its components.), Most of it still depends on the industry on the island of Java.
   - Even though there is already a signal of bank credit support for the new renewable energy industry, banks are still not too brave to invest in the new renewable energy industry from sea because it has not been proven concretely (There are no success story)
   - Support from the transportation industry is abundant and ready for shipping outside Java via shipping routes to small ports (sea Toll program), but support for facilities and infrastructure at ports and assembly sites outside Java needs to be more prepared.
2. Even so, as a very large archipelagic country, it is necessary to start a brave industry pioneer in the development of the marine new renewable energy industry (such as PT. PAL Indonesia), although it requires a commitment to banking support, especially for industries that are not as big as PT. PAL Indonesia.

9. Recommendation:

1. The government (central/regional government) needs to immediately prepare a legal protection for support of the new renewable energy industry from sea
2. In terms of the readiness of the shipbuilding industry and the metal industry (especially in Java), it is necessary to immediately prepare for the establishment of a supply chain for industry from sea.

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