DEVELOPMENT OF SUSTAINABLE MARITIME INDUSTRY TO STRENGTHEN REGIONAL INNOVATION SYSTEM IN LAMONGAN REGENCY

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Abstract

Since 2007 Indonesian governments try to encourage every region to develop their regional innovation system (RIS) based on national innovation system (NIS). Lamongan is one of the regencies located on the north coast of East Java, it has long coastline along 47 km. Realize of potential Lamongan in their maritime sector, Ministry of Industry Indonesia and East Java Government has established the northern region of Lamongan Regency especially in Brondong sub-regency as a special economic region for maritime industry sector land with ± 450 hectares that will be developed soon. In order to develop their Regional Innovation System, Lamongan Regency government agreed to using theme "Development of Sustainable Maritime Industry Based Mina-Agro-Tourism". Leading sector of maritime industries in Lamongan is shipbuilding yard and fisheries. Bring the sustainable concept to shipbuilding industry can increase competitiveness of a shipyard and increase opportunity to reach new market. Maritime industries involving various supporting industries that made maritime industries become a complex industrial estates, therefore this research choose system dynamic approach to formulate linkage between each parties for establishing the appropriate policy for development maritime industry with environmental sound in order to strengthen regional innovation system in Lamongan regency.

Keywords
Green Technology, Sustainable, Regional Innovation System

1. Introduction

1.1. Background

In this era globalization, improvement of competitiveness and social cohesion become a major factor to uplift people's prosperity, to build autonomy, and advance civilization of the nation. It is increasingly understood that competitiveness is not only influenced by natural resources, but also artificial factors, especially knowledge development, utilized and disseminated to encourage the continuous development of innovation and diffusion. (Su and Chen 2015) (Ferretti and Parmentola 2015)

One of the issues that become a program in Lamongan Regency for their medium term development plan 2016-2021 is the implementation of Sustainable Development Goals (SDG's) to continue the Millennium Development Goals (MDG's) as a commitment of the Indonesian government. Indonesia is one of the countries that ratify SDG's as a global development agreement. Vice President Yusuf Kalla was attended the United Nations General Assembly on September 25th, 2015 in New York, USA together with leaders from 193 countries in the world. (Kabupaten Lamongan 2016) So in this case the government also contribute in the development of knowledge for innovation, realizing the continuous growth of Indonesia's economic growth, set the main strategy in encouraging the added value of the leading sectors of the economy, infrastructure and energy development, Human Resource Development and Science and Technology. (Tim BPPT 2012)

Table 1. Comparing Long-term Development Planning National, East Java, and Lamongan

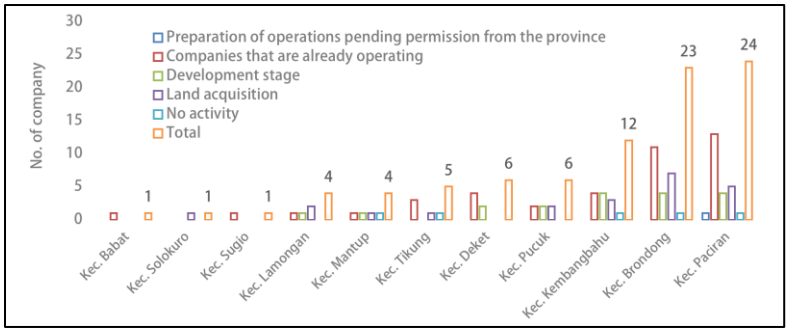
National Long-term Development Planning 2005-2025 (*)		**East Java Province Long-term Development Planning 2005-2025 (**)**		**Lamongan Regency Long-term Development Planning 2005-2025 (***)**	
Stages	*Mission*	*Stages*	*Mission*	*Stages*	*Mission*
3rd Stages (2015-2019)	Strengthen overall development in various fields by emphasizing the achievement of economic competitiveness on the basis of competitiveness of natural resources and qualified human resources and sustainable technology	**3rd Stages (2015-2019)**	Strengthen overall development in various fields by emphasizing the achievement of economic competitiveness on the basis of competitiveness of natural resources and qualified human resources and sustainable technology	**3rd Stages (2016-2020)**	Strengthen overall development in various fields by emphasizing the achievement of economic competitiveness on the basis of competitiveness of natural resources and qualified human resources and sustainable technology

Source: * *Rencana Jangka Panjang Nasional 2005-2025*
** *Rencana Jangka Panjang Provinsi Jawa Timur 2005-2025*
*** *Rencana Jangka Panjang Kabupaten Lamongan 2005-2025*

As we can see from the (table 1) above that the long-term development objectives in the third stage, both at the national, provincial and Regency levels formulate the same objectives i.e. "Strengthen overall development in various fields by emphasizing the achievement of economic competitiveness on the basis of competitiveness of natural resources and qualified human resources and sustainable technology" as their mission.

Implementation and development of innovation will be greatly influenced by how the actors that exist in a community (at the company level, region and country) take a part. To synergize the very diverse activities of various actors that play a role in innovation required a system mechanism, the system is called the innovation system. The innovation system can occur in the micro level of the company (sector innovation system or industrial cluster), regional level (Regional Innovation System), or in national level (National Innovation System). (Chung 2002)

The concept of Regional Innovation Systems (RIS) since the early 1990's has gained the attention of policy makers and academic research as a framework for analysis to advance our understanding of regional economic innovation processes. The popularity of RIS is closely linked to the emergence of regional autonomy identified with industrial group activities as well as the surge in RIS policies, where the region is regarded as the most appropriate scale of innovation-based learning to sustain the economy. (Cooke, et al 1997)



Sources: Lamongan Dalam Angka, 2016

Figure 1. Number of companies investing in Lamongan Regency

East Java Provincial Government has designated the northern region of Lamongan Regency especially Kecamatan Brondong as a Special Economic Zone (SEZ) maritime industry sector which will soon be developed with the initial phase of land area is provided about 200 hectares. In this location is now available land for shipping industry of 4,000 hectares. Brondong also has the longest beach compared to the location of other industrial areas, located along the northern coast of Lamongan Regency. The location is very strategic because it is adjacent to the port of Sedayu Lawas (Gresik) in east side and far enough separated from the settlement. The SEZ maritime industry will focus on the shipping industry and fisheries and aquaculture ranging from the provision of raw materials, production technology, reparation / maintenance, marketing for both domestic and export markets. In this research we aim to focus on development of sustainable maritime industry.

Institute of Marine Engineering Science & Technology (IMarEST) conduct survey around 150 respondent in SE Asia from different background business core i.e. Ship builder, Ship owner, Ship operator, equipment manufacture, charterer, other. Supported by Colfax Fluid Handling they surveyed in 2 different location in UK companies and South East Asia companies they also received from other regions out of their targeted. The surveys resulted that 96% of the industry in South East Asia confirmed that the green agenda is worthy for the global maritime industry otherwise in UK only 88% agree with that, and 62% thought it offers good value for money. (IMarEST and Science & Innovation Network (SIN) 2014)

The main weakness of the national shipyards in Indonesia is not matter of time to deliver variables, the cost or the actual performance of our shipyard is relatively competitive. The most critical is the need for development and investment of production facilities that need to be taken seriously. Indonesia's main shipyard utility has reached an average of 70% (Santoso, et al 2014). Bring the concept green to shipbuilding industry can increase competitiveness of a shipyard (Jiang, et al 2013; Mickeviciene 2011).

Indonesian government promotes facilitation and incentives in order to increase competitiveness and productivity prioritized at: (1) strategic industries according to National Industrial Policy; (2) the maritime industry; and (3) labor-intensive industries. Developing marine industry in stages and integrated through inter-industrial linkages and between industrial sectors with other economic sectors, especially with the economic sector that supplies industrial raw materials (Republik Indonesia 2014)

1.1. Research Problem

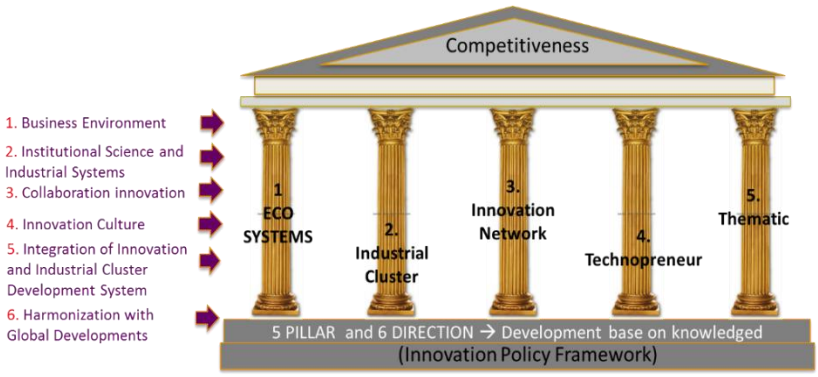
Regional Innovation System in Lamongan Regency have main theme Development Maritime Industry Based on Agro-Mina Tourism that put forward sustainability as their focused for development in Regional Innovation System. East Java Province government based on Ministry of Industry medium term development plan agree to set Lamongan Regency as special economic region for maritime industry especially for shipbuilding. Therefore this study have some research problems as follows:

1. Readiness of local governments to establish and develop regional innovation systems to support development sustainable maritime industry in Lamongan.
2. Formulate linkage indicator for establishing the appropriate policy for development sustainable maritime industry
3. Creating a model structure, based on the relationship and cooperation between all stakeholders determinants

1.2. Regional Innovation System in Lamongan

Ministry of Industry Indonesia and East Java Government has established the northern region of Lamongan Regency especially in Brondong sub-regency as a special economic region for maritime industry sector land with 200 hectares that will be developed soon. Through regent regulation No 188/287/Kep/413.013/2017 stated that Lamongan Regency government agreed to develop their Regional Innovation System by using theme "Sustainable Maritime Industry Based Mina-Agro-Tourism" this theme is an attempt to enhancing competitiveness of maritime industries in Lamongan.

Enhancing competitiveness and strengthening social cohesion can be done by increasing innovation system. One of pillar to achieve national competitiveness can be through enhancing regional competitiveness, therefore it's important for government to support their regions to increase competitiveness through Regional Innovation System. (Tim BPPT, 2012) Indonesia law no. 23 year 2014 about regional autonomy demanding regional government to be able establish their long-term plan of the region. Law No. 03 and No. 36 year 2012 discussed about regional innovation system in these enactment. In order to establish regional innovation, Minister of Research and Technology together with Minister of Home Affairs establish National team coordination strengthening regional innovation system



Sources:(Tim BPPT 2012)

Figure 2. Innovation policy framework

Development of innovation in the industrial context is intended to improve the quality and productivity of the company or business units in producing goods and services that can compete in both local and international markets. This competitive ability is due to its high interaction with universities and science and technology development institutions in producing knowledge, and supply of human resources of science and technology. Regional development should emphasize development policies based on the specificity of the region concerned (endogenous development) by using local human resource, institutional and physical resource potentials. This orientation leads to the taking of local initiatives in the development process to create new employment opportunities and stimulate economic activity.

Through the Joint Regulation between the Minister of Research and Technology with the Minister of Home Affairs, in efforts to improve the capacity of local government especially related to efforts to improve the competitiveness of regions through Strengthening Regional Innovation System (RIS). The Joint Regulation mandates that each region of both the Province and the Regency/City should establish the policy of Strengthening the Regional Innovation System (RIS), which in the regional economic development planning becomes an integral part of the Regional Development Master Plan and it's included in the Regional Medium Term Development Plan and has a good influence to achieve the expected economic development goals. Especially in elaborating the potential to increase economic development as well as create profitable business opportunities in accelerating the regional economic growth.

2. Sustainable Maritime Industries

2.1. Maritime industries role in Lamongan

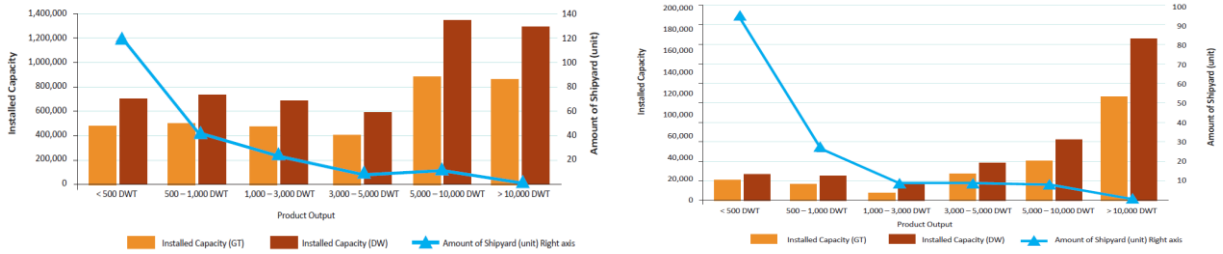
Maritime industry play a significant role in development of country, maritime industry not just dealing with ships but also involving process movement of goods and its vessel shipments both locally and internationally. In many country maritime industry become a key sector of the economy that can create a lot of opportunities for opening up new jobs. Some researchers called maritime industry as economy builder and sustainer with lots of opportunities, innovation,

and development. Maritime industry contains all company that involve in the line of business. The business that involve to the maritime industry are as follow: (Kwak, et al, 2005; Antapasēs, et al, 2009; Hammervoll, et al, 2014)

Table 2. Business involve in Maritime industries

1. Ship design services	6. Shipyards
2. Construction and manufacturing	7. Customs brokerage services
3. Operation and supplying	8. Marine fishing
4. Ships repair / docking	9. Shipping and freight forwarding services
5. Component parts	10. Oil and gas and renewable energy

East Java Provincial Government has designated the northern region of Lamongan Regency especially Brondong region as a Special Economic Zone (SEZ) maritime industry sector which will soon be developed with the initial phase of land area is provided about 200 hectares. In this location is now available land for shipping industry of 4,000 hectares. Brondong also has the longest beach compared to the location of other industrial areas, located along the northern coast of Lamongan Regency. The location is very strategic because it is adjacent to the port of Sedayu Lawas (Gresik) in east side and far enough separated from the settlement. The SEZ maritime industry will focus on the shipping industry and offshore facilities ranging from the provision of raw materials, production technology, reparation / maintenance, marketing for both domestic and export markets.



Sources: (JICA 2011)

Figure 3. National Shipyard Capacity

The development of shipping industry in Lamongan requires technological innovation to be able to compete with domestic shipyards in other regions such as Batam, Jakarta, Balikpapan and overseas areas such as Singapore, China and Korea. The national shipbuilding industry needs to be more reactive due to the need of supply new shipbuilding until 2020, in line with the national target of achieving the domestic cabotage principle. The demand for new vessels and existing ship repairs in this area is huge, following the establishment of Lamongan regency especially in north coast region by the government as a Special Economic Zone of the maritime industry. There are 5 existing companies in Lamongan with large scale (up to 30.000 DWT) shipbuilding industry, as follows:

1. PT. Dok Pantai Lamongan
2. PT. Lamongan Marine Industry (LMI)
3. PT. Dok dan Perkapalan Surabaya (DPS)
4. PT Tri Ratna Diesel Indonesia
5. PT Daya Radar Utama Lamongan

The productivity of vessel repairs in shipyard can handle up to 30 ships per year. Repair period of small damaged ship takes time around 8 - 10 days, and repair period for major damage around 8 - 14 days. The cost of repairing minor damage around IDR 200 million - IDR 300 million / ship, while the cost for repair major damage about Rp750 million / ship.

The development of shipping industry in Lamongan requires technological innovation, if they want be able to compete with other regions such as Batam, Jakarta, Balikpapan as well as overseas areas such as China and Singapore. The study of concepts as well as some empirical evidence of their successful practice experience shows that the competitiveness and social cohesion of a country, region or society is strongly influenced by the development of the "innovation system" of the country, region or community concerned.

The Lamongan Integrated Shore-base (LIS) development plan, which is generally a concept as well as an entity that facilitates the use of resources and exploration-production facilities in the oil and gas sector so it can assist in the achievement of efficient operations through supply chain arrangement and distribution of goods. An integrated of the “One Stop Hypermarket” concept is that all services, goods, and all oil industry supporting activities are available at LIS by applying an integrated logistics service in one place.

The existence of Lamongan Integrated Shore-base (LIS) is a commitment from the Lamongan Regency to support the oil and gas industry activities in East Java. Currently, East Java has the third largest oil and gas reserves in Indonesia. No wonder the world's major oil and gas companies i.e. Santos, Exxon, and Caltex invest millions of dollars in oil exploration activities here. The strategic role of this port is to support contractor logistics for the production sharing contract of oil and gas PSC in East Java and eastern Indonesia (KTI). With Lamongan Integrated Shore-base (LIS), it is expected that the operating costs of oil and gas companies operating in East Java and East Indonesia will be more efficient.

2.2. Lamongan Regency Fisheries and Blue Growth

At the 32nd FAO Regional Conference for Asia and the Pacific held in Ulaanbaatar, Mongolia in March 2014, FAO reveal data that currently fish production just serve 20 percent of protein needed by people diets and in 2030 demand of fish will be face incremental by 30 percent along with increasing of population and global economic growth. Aquaculture seems to be most suitable to meet increasing demand of fish due to stagnancy in marine fisheries production. Policy from marine and fishery ministry for banning illegal fishing practices successfully boosted national fish stocks. Data from the National Fish Assessment Commission, in 2014 the Indonesian fish stock is only 6.5 million tons. However, in 2016 has reached 12 million tons. Peoples fish consumption figures also increased from 36 kg per capita in 2014 to 43 kg per capita in 2016 which is increase 19% within 2 years.

Indonesia as an archipelagic country has the potential of marine resources in the form of a very high fishery, East Java has 79 small islands centered on the Madura Islands. The amount is only 0.44% of the total islands in Indonesia. Based on data from the East Java Provincial Fisheries Office that East Java has a coastal length of about 16,000 km with sea fish production reaching 288.816 tons. Data from Fishery Service of Lamongan Regency, in 2016 Lamongan Regency has a production of fish as much as 73.142 tons, coming from 5 Fish Landing Base (PPI) in Lamongan Regency worth a value of IDR 1.100.262.490 and from cultivation sector the production reach 54.300 tons worth a value IDR 1.267.862.840.Lamongan regency has the largest fishing industry in East Java. For more details can be seen in the table below:

Table 3. Marine Fisheries Production in Lamongan Regency 2005-2016

Marine Fishery Production In The Port Sector

No	Year	Grand Total		
		Volume (ton)	Value (Rp.000)	Price average/Kg
1	2005	39.934	849.284.460	21.267
2	2006	46.569	800.066.350	17.180
3	2007	37.618	884.075.150	23.501
4	2008	63.594	1.352.516.000	21.268
5	2009	63.912	1.354.131.000	21.187
6	2010	61.432	629.728.570	10.251
7	2011	68.302	779.193.850	11.408
8	2012	63.216	806.366.420	12.756
9	2013	70.150	820.430.420	11.695
10	2014	71.553	866.462.840	12.109
11	2015	72.346	940.041.820	12.994
12	2016	73.142	1.100.262.490	15.043

Cultivation fish production

No	Year	Grand Total		
		Volume (ton)	Value (Rp.000)	Price average/Kg
1	2005	31.266	294.733.050	9.426
2	2006	28.337	240.200.000	8.477
3	2007	28.257	257.284.410	9.105
4	2008	31.952	360.284.410	11.276
5	2009	33.803	736.876.000	21.799
6	2010	38.112	580.525.580	15.232
7	2011	39.691	513.741.600	12.944
8	2012	40.242	703.498.340	17.482
9	2013	42.185	794.786.060	18.840
10	2014	45.419	1.001.526.070	22.051
11	2015	49.569	1.180.439.730	23.814
12	2016	54.300	1.267.862.840	23.349

Source: Fishery Service of Lamongan Regency

As we can see from the data (Table 3) above, production of marine fishery in Lamongan Regency is always increasing year by year increase around ±3% each year. From the historical data at the table, we can analyze from marine fisheries sector in Lamongan the production of fish each year are always increasing it is happened due to technology of fisherman are well equipped make their catching capacity are increasing, but inversely proportional to price average of fish per kilogram are decreasing due to oversupply can make the price of fish will be decrease. Different from marine fishery sector, the cultivation fish sector have positive incremental both in production volume and price of the fish as well, the volume of cultivation in Lamongan are relative similar with marine fisheries volume production it makes marine cultivation can be the future option for sustainability of fisheries in Lamongan to boost regional economic.

2.3. Sustainable Maritime Industry Concept

In Master plan Acceleration and Expansion of Indonesia Economy (MP3EI), Indonesian government establish national development plan for accelerate their economic development, In order to achieve it, Indonesia need to try a new way of thinking, a new way of working, and a new way of conducting business. Regulations at the central and regional level must be efficient to simplify doing business. A new way of thinking should be based on the spirit of "Not Business as Usual" to expedite the economic development in Indonesia, it rely on the private sector participation which includes state-owned enterprises, and private domestic also foreign investors. (Indonesian Ministry for Economic Affairs 2011)

Rising of environmental consciousness drive industry to evaluate their goal and thing about changing how they do a business become more environmental friendly. Sustainable shipbuilding needs the support of a good financial system to sustain its innovation requirements for social, economic, and environmental sustainability. In the future ships will become more sophisticated in every aspects i.e. design, construction and operation. (IMO 2013) Whilst existing ships will be intended to meet the efficiency nor the demanding of environmental friendly, which will lead them to change their regular operational habit and to comply with required statutory for retrofitting equipment. Furthermore how to do business in shipyard should put innovation to maximize the benefits of innovation and new technology for sustainability of shipyard and environmental awareness and for the cost effectiveness of the company. The concept are as follow:

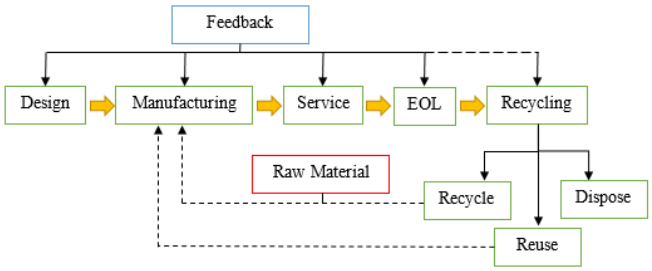


Figure 4. Sustainable shipyard industries concept

Shipbuilding industries is a heavy industries with chemical and hazardous material for human and environmental involved during the production. Most of conventional production process such as welding, cutting, painting, blasting, etc. given a huge impact to the risk even on workers' health and safety nor the environmental. This made shipbuilding industry well known as high energy consumption, high material consumption, and high pollution industry. Green shipbuilding purposed is to minimize waste and hazardous emission during design, manufacturing, service, and dismantling in order to minimize pollution to environment (air, water, and soil), contribute in saving resources, and give positive impact to social and economic. (Rahman and Karim 2015)

In order to answer the challenge of sustainability of maritime industry, NaSDEC Indonesia as research center of ship design should provide a green ship design that will be a master design of national fleet in the future. Green ship will rely on its design phase that make them generate minimum influence on the environment during manufacturing and service. Rahman and Karim 2015 give concept for green ship design:

1. Reduce the consumption of materials and energy and minimize the pollution to environment in ship manufacturing and service
2. Recycle parts and accessories in ship maintenance
3. Reuse the majority of materials after ship dismantling

Furthermore, green shipyard should put forward the efficiency of materials and energy used in shipbuilding process, also minimize hazardous emission and expedite the process of hull construction, outfitting, and painting.

3. System Dynamic Modelling

3.1. Causal loop Lamongan Maritime Industries

Maritime industries is a complex environment involving many parties, in order to make a decision in policy making we need observe the real condition into the model system, it can be done through building a system dynamics modeling through four stages as follow:

- Observation of reality,

- Conceptualization,
- Interpretation, and
- Utilization of the results of modeling.

Observations of reality will result in the framework of the concept shown in causal loop diagram (CLD). The causal loop diagram is not a model, it cannot used as policy analysis, find the leverage points, nor find which one the loop is prominent with just a causal loop diagram. Relationship of causality (causal loop diagram) between maritime industries in Lamongan can be figured as follow:

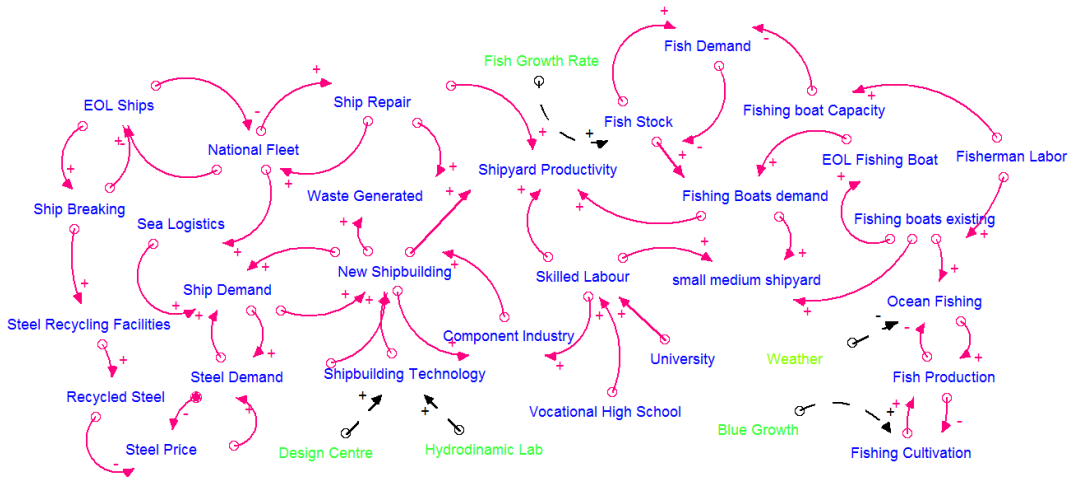


Figure 5. Causal Loop of Sustainable Maritime Industries in Lamongan

3.2. Flow Diagram Analysis

Based on the causal loop diagram, we can developed flow diagram analysis to see behavior of existing condition based on three supporting data:

1. Historical Statistical data
2. Observation
3. Expert Judgment

All the data are input to the model so we can make future analysis by using this flow diagram. This model are consist of several sub-model, each sub model are based on the data that have been collected before.

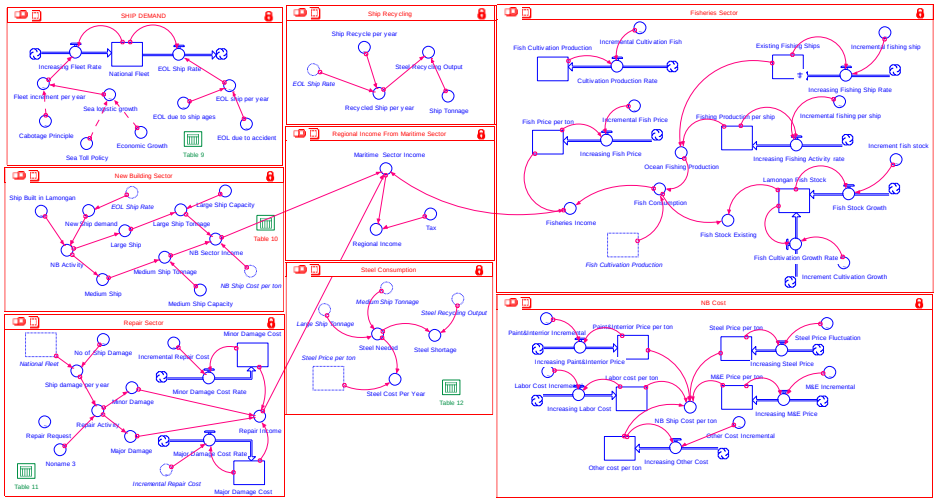


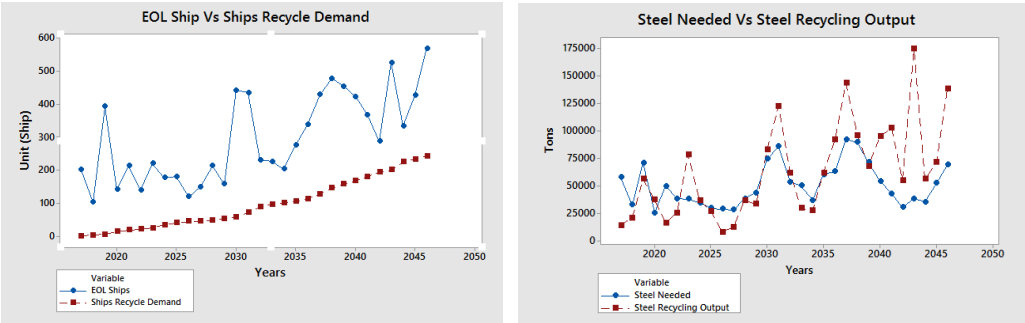
Figure 6. Flow Diagram of Sustainable Maritime Industries Model

As we can see in (Figure 6) above, all indicators are represented in flow diagram model, so from this model we can analyze the factor should be we focused on to develop sustainability in maritime sector of Lamongan regency. The

sector that included in this model are from shipyard industries and fisheries industry, this model try to find linkage between these two industries and find solutions for sustainable operation and the linkage between them to regional income.

3.3. Results

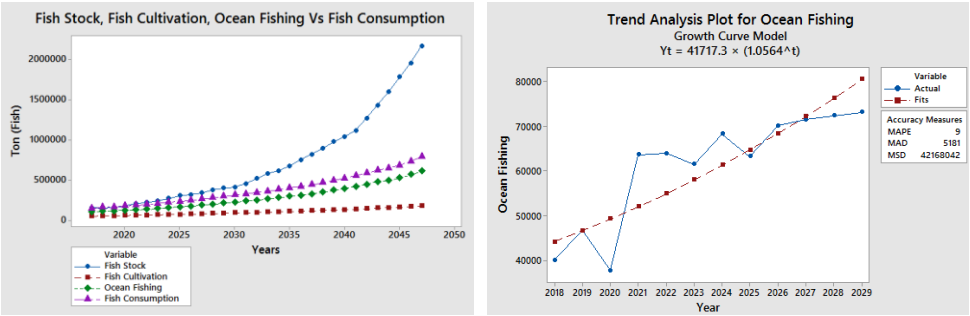
From the stock flow diagram before, we can analyze the contribution between variable to developed sustainability. From the shipyard industries the most issues is about ships dismantling. Ship dismantling also known as ship recycling is a process of scrap a ship when it comes to end its lifetime (EOL) due to commercial nor technical factors. From the historical data and then input in to the model, the result of forecasting in ship recycle demand for next 30 years are as follow:



(a) (b)

Figure 7. (a) Ship Recycle demand forecast; (b) Steel input from ship recycle forecast

From (Figure 7) above, we can see that in the future demand for ship recycle will be increased due to age most of Indonesian fleet are above 25 years old. From the analysis in stock flow diagram, it shows the results that steel recycling support 20%-60% steel needed of Lamongan shipyard and even surplus. Data from The World Steel Association in 2016 revealed that price of recycle steel are 30%-40% cheaper than steel production from steel ore, it means put the ship dismantling and recycling facilities in Lamongan can increase competitiveness of shipyard because they can save money by using recycled steel, and it also means more labor can be absorb by this facilities.



(a) (b)

Figure 8. (a) Fisheries Industries Sector forecast by dynamic system method; (b) Ocean Fishing forecast by using trend analysis

Another industries that support regional income from maritime industries are from fisheries industries. As we can see from (Figure 8) above fish cultivation still below the ocean fish production, compared with forecast results by using method moving average it's also shown the similar of graphical pattern that the fishing production relatively increasing every year due to increasing demand of fish in the market. From this result of stock flow diagram in fisheries sector that Lamongan should increase their potential land for cultivation fish, it's because the future of fish stock in the sea could be depleted due to over fishing by the local fisherman. Impact of policy from the Ministry of Maritime Affairs and Fisheries that requires fishermen to use environmentally friendly fishing gear and give hard punishment for IUU (Illegal, Unreported, and Unregulated) fishing practices given positive impact and make national fish stocks rise, but also we can make another option to keep this industries to be sustainable.

Conclusion and Suggestion

As the result of analysis that already done, sustainability of maritime industries in Lamongan regency are really needed to boost regional income and create more jobs for local people. Sustainable shipyard have advantages in increased their reputation in market, due to their "sustainable" labels as differentiate to their competitor who just using conventional business. By concerning on development sustainable maritime industry and process innovation support with green managerial innovation, will lead to potential of cost savings, efficiency, increased productivity and better product quality. Development of sustainability is an effort to exploit all the potential that exists in Lamongan regency. This Regional Innovation Capacity Model captured which one regional systems source of knowledge they need to perform innovation, convert the knowledge into an innovation capacity manage innovation processes and then utilize innovation outcome to establish growth and development in their regions. For the further research will be needed for calculation in feasibility of ship dismantling and recycling facility investment and then calculate how much land needed for fish cultivation to support blue growth in Lamongan regency.

Acknowledgements

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References

Antapasēs, Antōnios M., Lia I. Athanassiou, and Erik Røsæg. 2009. *Competition and Regulation in Shipping and Shipping Related Industries*.

Chung, S. 2002. "Building a National Innovation System through Regional Innovation Systems." *Technovation* 22(8):485–91.

Cooke, Philip, Mikel Gomez Uranga, and Goio Etxebarria. 1997. "Regional Innovation Systems: Institutional and Organisational Dimensions." *Research Policy* 26(4–5):475–91.

Ferretti, Marco and Adele Parmentola. 2015. *The Creation of Local Innovation Systems in Emerging Countries: The Role of Governments , Firms and Universities*.

Hammervoll, Trond, Lise Lillebrygfjeld Halse, and Per Engelseth. 2014. "The Role of Clusters in Global Maritime Value Networks." *International Journal of Physical Distribution & Logistics Management* 44(1/2):98–112.

IMarEST and Science & Innovation Network (SIN). 2014. "Green Ship Technologies."

IMO. 2013. "World Maritime Day - Concept of a Sustainable Maritime Transportation System." 34.

Indonesian Ministry for Economic Affairs. 2011. *Master Plan Acceleration and Expansion of Indonesia Economic Development 2011-2025*. Ministry for Economic Affairs.

Jiang, Liping, Erik Bastiansen, and Siri P. Strandenes. 2013. "The International Competitiveness of China's Shipbuilding Industry." *Transportation Research Part E: Logistics and Transportation Review* 60:39–48.

JICA. 2011. "Study on the Development of Domestic Sea Transportation and Maritime Industry in the Republic of Indonesia (STRAMINDO)."

Kabupaten Lamongan. 2016. "RENCANA PEMBANGUNAN JANGKA MENENGAH DAERAH (RPJMD) KABUPATEN LAMONGAN TAHUN 2016-2021."

Kwak, Seung Jun, Seung Hoon Yoo, and Jeong In Chang. 2005. "The Role of the Maritime Industry in the Korean National Economy: An Input-Output Analysis." *Marine Policy* 29(4):371–83.

Mickeviciene, Rima. 2011. "Global Competition in Shipbuilding Trends and Challenges for Europe." *The Economic Geography of Globalization* (September):201–22.

Rahman, Aevelina and Mashud Karim. 2015. "Green Shipbuilding and Recycling : Issues and Challenges." *International Journal of Environmental Science and Development* 6(11):838–42.

Republik Indonesia. 2014. *RENCANA PEMBANGUNAN JANGKA MENENGAH NASIONAL 2015-2019*.

Santoso, Eko Budi, Ummi Fadlilah Kurniawati, and Ajeng Nugrahaning Dewanti. 2014. "Faktor-Faktor Pengembangan Kawasan Khusus Industri Perkapalan Untuk Mendukung Sistem Inovasi Daerah." *Jurnal Ekonomi Pembangunan* 15(2):141–51.

Su, Yu-Shan and Jin Chen. 2015. "Introduction to Regional Innovation Systems in East Asia." *Technological Forecasting and Social Change* 100:80–82.

Tim BPPT. 2012. *Naskah Akademik Buku Putih Penguatan Sistem Inovasi Nasional*. edited by Deputi Bidang Pengkajian Kebijakan Teknologi BPPT. Jakarta.

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