Integrated ship recycling industrial estate design concept for Indonesia

Sunaryo¹ and Bagus A Tjitrosoemarto²

¹. Naval Architecture and Marine Engineering Study Program, Universitas Indonesia, Kampus UI Depok 16424, Indonesia. E-mail: naryo@eng.ui.ac.id
². Naval Architecture and Marine Engineering Study Program, Universitas Indonesia, Kampus UI Depok 16424, Indonesia. E-mail: bagusarya.tj17@gmail.com

Corresponding author’s e-mail: naryo@eng.ui.ac.id

Abstract. Since the implementation of the cabotage principle, the number of Indonesian flagged ships has been increasing significantly, due to the government’s incentive on importation tax for used ships. The fleet is dominated by old ships, which most of them will soon be sent for recycling. The ship recycling industry has a great opportunity for the economy of Indonesia, because of its contribution to the steel industry and job creation, but on the other hand it is also a very environmentally unfriendly industry. Currently there is no ship recycling yard complies with the requirements of international and national regulations, most of them are still implementing conventional method, and are not connected to the supporting industries. Based on these issues the study was aimed to design a concept of an integrated green and sustainable ship recycling industry estate, which has all necessary industries and facilities in it, and efficiently connected with each other. Block Plan program was used to optimize the arrangement. It is proposed that five ship recycling yards, large; medium; and smaller capacity, steel mill, waste treatment facility, electricity power plant, fresh water facility, training centre, workers accommodation, hospital, and bus terminal should be included in the estate.

Keyword: ship recycling, industrial estate, integrated, environmentally friendly

1. Introduction

Indonesia is the world’s largest archipelago, therefore shipping and shipbuilding industry play important role in the development of Indonesia’s economy. Based on the data published by the Ministry of Transport in 2019 [1], there were 80,849 Indonesian flagged ships registered. But the data also stated that about 22,000 of the ships were aged between 20 to 40 years, which subject to be renewed and sent for shipbreaking. The great number of old ships conceives opportunity to the ship recycling industry to provide the high demand of steel scrap as raw materials to the steel industry, used plates and sections for ship-repair yards, used engines and equipment for replacement in old ships, and creating job. Ship recycling is defined by the Ministry of Industry [2] as the process of recycling old or unfit for operation ships by scrapping the steel, and reusing or reconditioning their equipment and supplies. Beside its potential benefit, ship recycling industry is also known as risky and environmentally unfriendly maritime industry. Based on the investigation of Sunaryo et al [3] in three ship recycling centres in Indonesia, namely Bangkalan in Madura Island, Cilincing in North Jakarta, and Tanjung Uncang in Batam Island, there is no ship recycling yard in Indonesia that complies with the requirements of both national and international regulations, and most of the existing ship recycling...
yards are still using conventional method, such as beaching the ships before dismantling them, using manual tools to break the ships and dismantle their equipment and components, no consideration on the pollution to the surrounding environment, and the health of the workers. Moreover the ship recycling centres are located far away from their related industries, such as the steel mill, used ship equipment and components market, waste treatment facility, and ship-repair yards, so that the industry is difficult to develop into green and sustainable industry, and economically efficient. Challenged by this condition, the study is aimed to develop a concept of an integrated ship recycling industrial estate, which at least accommodate all necessary related industries, facilities, and infrastructure in it to support for the fulfilment of the requirements of national and international regulation efficiently and cost effectively, by shortening its supply chain system. Refer to the number, types, and sizes of existing ships operate in Indonesia, and based on the sizes of ships have been recycled in three main ship recycling centres, there are three categories of ship recycling yards included in the proposed ship recycling industrial estate, i.e. large ship recycling yard, which able to recycle ships up to 30,000 dwt, medium, with capability to recycle between 5,000 dwt to 10,000 dwt ships, and small ship recycling yard, with capacity to recycle ships under 5,000 dwt. There is no specific location proposed in the design concept, but consideration on the practicality for application was taken.

2. Method
The study was conducted based on the guidance and requirements of the existing national and international regulations, and other information obtained from literature study, and for deciding the layout of the supporting industries and related facilities in the industrial estate Bloc Plan programme was utilized. The national regulations related to industrial estate and ship recycling activities that are taken as reference in the study are: Government Regulation No. 142 – 2015 on industrial estate [4], Regulation of the Minister of Industry No. 40 – 2016 on the technical guidance of industrial estate [5], Regulation of the Minister of Transport No. 29 – 2014 on the prevention of pollution on maritime environment [6], Government Regulation No. 101 – 2014 on the management of toxic and hazardous materials [7]. And the international regulations are: IMO’s Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009 [8], which is known as the Hong Kong Convention, IMO Resolution of the Marine Environment Protection Committee 210 -2012 on the Guidelines for Safe and Environmentally Sound Ship Recycling [9], IMO Resolution A 962 – 2003 on the Guidelines On Ship Recycling [10], and the International Labour Organization’s (ILO) Safety and Health in Ship-breaking: Guidelines for Asian Countries and Turkey [11].

2.1. Government Regulation No. 142 – 2015 on industrial estate
Industrial estate as defined by the Government Regulation No. 142 – 2015 on industrial estate is an estate where industrial activities are concentrated, and equipped with supporting infrastructure, which is developed and managed by an industrial estate enterprise. The objectives of an industrial estate are: to accelerate the equal distribution of industry development, to increase the effort on developing environmentally friendly industry, to increase the investment and industry competitiveness, and to provide certainty on industrial location spatial. The minimum area of an industrial estate is regulated not less than 50 hectares, unless it is allocated for small and medium industries, which may not less than 5 hectares. According to this regulation, there are two types of infrastructure should be provided i.e. industry infrastructure and supporting infrastructure. Industry infrastructure includes: supply of energy and electricity, telecommunication network, supply of raw water and fresh water, sanitation system, and transportation infrastructure. Supporting infrastructure includes: housing, training centre, research and development centre, health centre, fire fighting station, and waste treatment facility.

2.2. Regulation of the minister of industry no. 40 – 2016 on the technical guidance of industrial estate
Regulation of the Minister of Industry No. 40 – 2016 on the technical guidance of industrial estate requires that an industrial estate should comply with the Government’s master plan on the usage of land, environmentally friendly, and efficient in its operation and services. The distance of the
industrial estate to the city centre is minimum 10km, 2km from the community housing. Proportion of the land usage should be: 70% for industry, 8 – 10% for road, green open space 10%, supporting infrastructure 8 – 10%.

2.3. Regulation of the minister of transport No. 29 – 2014 on the prevention of pollution on maritime environment

Regulation of the Minister of Transport No. 29 – 2014 on the prevention of pollution on maritime environment includes ship recycling in chapter 1, paragraph 2, chapter 2, and paragraph 51 to 56. It regulates the ships for recycling, ship recycling facilities, authorization to conduct ship recycling, and ship recycling facility plan, inspection of ship recycling, and report from ship recycling facility after finishing the ship recycling process.

2.4. Government regulation No. 101 – 2014 on the management of toxic and hazardous materials

Government Regulation No. 101 – 2014 on the management of toxic and hazardous materials defines waste treatment as activities to reduce, storage, collection, transporting, make use, treatment, and dumping of wastes. The waste storage can be in the form of: building, tank or container, silo, waste pile, waste impoundment, etc.

2.5. The Hong Kong convention

The Hong Kong Convention contains procedures for ship recycling that are safe for environment and workers at ship recycling facilities. It controls the management system of the ship recycling facilities, health and safety of the workers, and removal of hazardous materials, but it does not regulate how the wastes should be treated.

2.6. IMO Resolution of the Marine Environment Protection Committee 210 -2012 on the Guidelines for Safe and Environmentally Sound Ship Recycling

The guidelines provide stakeholders with recommendations for the safe and environmentally sound recycling of ships and implementation of the Hong Kong Convention, which include: facility management, facility operation, worker health and safety, environmental management. They also put considerations on the ship recycling process, relevant instruments of the International Labour Organization (ILO), and relevant instruments of the United Nations Environment Programme (UNEP).

2.7. IMO Resolution A 962 – 2003 on the Guidelines On Ship Recycling

With regard to the ship recycling the resolution assumes that recycling is one of the basic principles of sustainable development. It recommends that the obligation for environmental and worker protection are rest with the ship recycling facility and the national regulatory authorities. The ship recycling industry should establish control standards to ensure the safe and environmentally sound disposal of the end of life ships.

2.8. International Labour Organization’s (ILO) Safety and Health in Ship-breaking: Guidelines for Asian Countries and Turkey

The objectives of the guidelines are: to protect shipbreaking workers from workplace hazards and to prevent work-related injuries and diseases, ill health, and incidents, to assist establishing a national policy and principles on occupational safety and health and welfare of workers of the shipbreaking facilities and on the protection of the general environment, to assist establishing duties and responsibilities of the stakeholders and make arrangements for a structured cooperation between them, and to promote the implementation and integration of consistent occupational safety and health (OSH) management systems.

2.9. Bloc plan programme

The Bloc plan programme processes input data in the form of the number of industry players and the activity relationship between the industry players. The use of the Bloc plan programme is intended to help to obtain an optimal layout of the industry players in the estate.
3. Results and discussion
The proposed concept design of the ship recycling industry estate is based on the government regulations on the industrial estate, the requirements of the national and international regulations on the ship recycling activities, the characteristics of ship recycling industry, and the potential market of the ship recycling industry in Indonesia. It is suggested that there should be three categories of industries included in the industrial estate i.e. the core industry, which is the ship recycling yards, the supporting industries, that directly support the activities of the ship recycling processes, and the related facilities, that do not directly related to the ship recycling processes, but their existence are needed to support the industry in complying to the requirements of the regulations, and in achieving as an efficient, environmentally friendly and sustainable industry, as shown in figure 1.

![Figure 1. Industries in ship recycling industrial estate](image)

3.1. Core industry
Refer to the existing national flagged ships, and the types and sizes of ships have been recycled in local ship recycling yards, the core industry, which is the ship recycling yards are proposed to be consisted of one large ship recycling yard, which maximum capacity to recycle up to 30,000 dwt ships; two medium ship recycling yards with capacity to recycle 5,000 dwt to 10,000 dwt ships; and two small ship recycling yards with capacity to recycle ships up to 5,000 dwt. The proposed areas of lands allocated for each of these yards are shown in table 1.

| No | Ship recycling yard | Width m | Length m | Area m² | Quantity | Total area m² |
|----|---------------------|---------|----------|---------|----------|--------------|
| 1  | Small               | 125     | 250      | 31.250  | 2        | 62.500       |
| 2  | Medium              | 150     | 300      | 45.000  | 2        | 90.000       |
| 3  | Large               | 165     | 300      | 54.450  | 1        | 54.450       |
|    | **Total core industry area** |         |          |         |          | **206.950** |

3.2. Supporting industries
The supporting industries are suggested would consisted of: waste treatment facility, steel mill, electric power plant, fresh water plant, cutting gas supplier, telecommunication provider, used ship equipment market, and their allocated areas are shown in table 2.

| No | Industry                      | Width m | Length m | Area m² |
|----|--------------------------------|---------|----------|---------|
| 1  | Waste treatment facility       | 250     | 375      | 93.750  |
| 2  | Steel mill                     | 220     | 330      | 72.600  |
| 3  | Electric power plants          | 125     | 250      | 31.250  |
| 4  | Cutting gas supplier           | 50      | 75       | 3.750   |
| 5  | Used components market         | 100     | 200      | 20.000  |
| 6  | Telecommunication provider     | 75      | 150      | 11.250  |
| 7  | Fresh water plant              | 150     | 300      | 45.000  |

**Total Area** 277.600
3.3. Related facilities
The related facilities are suggested would consisted of bus terminal, hospital, accommodation flats, training centre, shopping centre, estate office, fire station, community facilities, green open space, and public infrastructure, such as roads and drainage, their allocated areas are shown in table 3.

| No | Facility               | Width m | Length m | Area m² |
|----|------------------------|---------|----------|---------|
| 1  | Bus terminal           | 60      | 120      | 7.200   |
| 2  | Hospital               | 100     | 150      | 15.000  |
| 3  | Accommodation flats    | 100     | 150      | 15.000  |
| 4  | Training centre        | 55      | 110      | 6.050   |
| 5  | Shopping centre        | 75      | 150      | 11.250  |
| 6  | Estate office          | 50      | 100      | 5.000   |
| 7  | Fire station           | 50      | 75       | 3.750   |
| 8  | Community facility     | 75      | 150      | 11.250  |
| 9  | Green open space       |         |          | 69.000  |
| 10 | Roads and drainage     |         |          | 62.000  |
|    | **Total area**         |         |          | **205.500** |

3.4. Estate lay out
In order to bring in the ships to be recycling to the ship recycling yards it was determined that the core industry should be located facing the estate’s sea water front, and therefore the Bloc plan programme is only used to allocate the supporting industries and the related facilities, but green open spaces, and roads and drainage were not included in the programme, because they just followed lay out of the estate. The layout of the estate is shown in figure 2, and its legend is presented in table 4.

![Figure 2. Lay out of the industrial estate](image-url)
There is no ship recycling industrial estate existed in Indonesia, therefore the proposed lay out and the area allocated for the ship recycling industrial estate are only estimated based on the ideal assumptions, secondary information, and requirements of the related regulations, with expectation that by integrating the industries in the form of industrial estate the supply chain of the ship recycling industry could be shortened. For the actual application further considerations are needed to suit the real condition of the geographical location, the market demand, and all the three categories of the industries.

### 4. Conclusion

The concept of ship recycling industrial estate was designed to integrate three categories of industries, i.e. ship recycling industry as the core industry, waste treatment facility, steel mill, electric power plant, fresh water plant, cutting gas supplier, telecommunication provider, used ship equipment market, as supporting industries, and bus terminal, hospital, accommodation flats, training centre, shopping centre, estate office, fire station, community facilities, green open space, and public infrastructure, such as roads and drainage, as the related facilities.

The ship recycling yards as the core industry are proposed to consist of one large ship recycling yard, which able to recycle ships up to 30,000 dwt, two medium yards, with capability to recycle between 5,000 dwt to 10,000 dwt ships, and two small ship recycling yards, with capacity to recycle ships under 5,000 dwt.

### References

1. Indonesia Shipping Line. 2019, State Must Be Present to Solve the Financial Problems of the National Shipbuilding Industry. Available online: https://www.indonesiashippingline.com/shipping/3529.negara-%E2%80%98perlu-hadir%E2%80%99-terus-atas-hambatan-finansial-industri-galangan-kapal-nasional.html (accessed on 20 October 2020). (In Indonesian).

2. Fariya, S., Manfaat, D., & Ketut Suastika, I. 2016, Technical Analysis of The Development of Ship Recycling Yard in Indonesia. The 2nd International Seminar on Science and Technology, Yogyakarta, Indonesia.
[3] Sunaryo S., et al, 2021, A Gap Analysis of Ship-Recycling Practices in Indonesia, Recycling, Vol.6 No. 3.

[4] President of the Republic of Indonesia, 2015, Government Regulation No. 142 – 2015 on industrial estate. Ministry of the secretariat of state Republic of Indonesia, Jakarta, Indonesia.

[5] Minister of industry Republic of Indonesia, 2016, Regulation of the Minister of Industry No. 40 – 2016 on the technical guidance of industrial estate. Ministry of industry Republic of Indonesia, Jakarta, Indonesia.

[6] Minister of transport Republic of Indonesia, 2014, Regulation of the Minister of Transport No. 29 – 2014 on the prevention of pollution on maritime environment, Ministry of transport Minister of Republic of Indonesia, Jakarta, Indonesia.

[7] President of the Republic of Indonesia, 2014, Government Regulation No. 101 – 2014 on the management of toxic and hazardous materials, Ministry of the secretariat of state Republic of Indonesia, Jakarta, Indonesia.

[8] IMO, 2009, IMO’s Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, International Maritime Organization; London, United Kingdom.

[9] IMO, 2012, IMO Resolution of the Marine Environment Protection Committee 210 -2012 on the Guidelines for Safe and Environmentally Sound Ship Recycling, International Maritime Organization; London, United Kingdom.

[10] IMO, 2003, IMO Resolution A 962 – 2003 on the Guidelines on Ship Recycling, International Maritime Organization; London, United Kingdom.

[11] ILO, 2004, the International Labour Organization’s (ILO) Safety and Health in Ship-breaking: Guidelines for Asian Countries and Turkey, International Labour Organization: Geneva, Switzerland.