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A Gap Analysis of Ship-Recycling Practices in Indonesia

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Abstract: Ship recycling is gaining attention in Indonesia due to the increase in end-of-life ships and uneconomical nationally flagged ships, and is considered a prospective source of economic development and employment opportunity, and yet conceivably poses a threat to the health and safety of workers and the environment. There are international and national regulations that govern ship-recycling activities to ensure that the hazardous impacts of the industry are minimized. We investigated the disparity between current ship-breaking practices in Indonesia and the requirements of related international and national regulations, with the findings intended for use as a stepping stone to proposing a strategy to establish a green and sustainable ship-recycling industry. A benchmark study of the world's leading ship-recycling countries was conducted, and a gap analysis was performed by comparing existing international and national regulations with current ship-breaking practices in Indonesia. We identified two types of ship-breaking practices in Indonesia: Conventional environmentally unfriendly ship-breaking method, conducted by most Indonesian ship-breaking yards, and a rather modern, more environmentally friendly method, conducted by ship-repair yards. However, neither of the practices met the requirements of the regulations, and improvements are therefore needed to make the ship-recycling industry more green and sustainable, and to gain international recognition.

Keywords: gap analysis; ship recycling; regulations; ship breaking; Hong Kong Convention



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1. Introduction

As the world's largest archipelago with more than 17,500 islands [1,2], Indonesia very much depends on sea transportation. Since 2005, the Indonesian Government has implemented the cabotage principle and offered incentives to national shipping companies to purchase used ships from abroad by waiving importation tax [3]. As a result, the number of ships in the national fleet increased significantly from around 6000 units in 2006 to more than 32,500 units in 2019, a growth of more than 540% over 13 years [4]. However, the fleet was dominated by old ships aged between 20 and 30 years, with 20% more than 25 years old [5]. It is reported that at least 500 ships need to be replaced and sent to the ship-breaking yards every year due, but there is no official information regarding where and how these ships were demolished [6]. It can therefore be assumed that there is a great domestic market for ship recycling, which represents the potential for economic development and employment. The market could be even greater if Indonesia could become an alternative to the world's current ship-breaking centres in South Asia (India, Bangladesh, and Pakistan) [7]. This development could be supported by upcoming more stringent international regulations that are being introduced by developed ship-breaking countries such as the European Union's Ship-Recycling Regulation [8].

The ship-recycling industry depends on the supply of ships to be recycled, and on the demand for the “products” of the recycled ships such as metal scraps, steel plates and sections, ship parts and components, ship accessories, etc. According to the Indonesian Iron and Steel Industry Association (IISIA) [9], approximately 6.5 million tons of steel and iron scraps are needed every year to satisfy the raw material demand of the local steel industry. Currently, about 70% of this scrap steel is supplied through foreign imports. A ship’s steel plates, sections, and components are usually used to replace worn-out structural materials or components of old ships, which are in high demand since there are so many old ships in operation. Due to the growing market, the ship-recycling industry is growing in Indonesia. According to Bois [10], most of these ship-recycling facilities are still implementing conventional practices that rely on a manual labour force.

To receive international recognition of its ship-recycling industry, the Indonesian Government is preparing to ratify the International Maritime Organization’s (IMO) Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009, also known as the Hong Kong Convention [11]. The Hong Kong Convention deals with safe and environmentally sound ship-recycling procedures to ensure that processes involved do not pose a risk to human health and safety or the environment. The aim is to improve current practices of ship breaking, which is widely known as one of the most dangerous occupations due to the high risks of harmful material exposure and accidents.

However, Indonesia ratifying the convention will not provide any real benefits unless its ship-breaking yards are also developed into green and sustainable facilities that comply with the requirements of the convention. At the moment, most of the yards still use the conventional ship-breaking method. In this study, we aimed to investigate the disparity between the current ship-recycling practices in Indonesia and the requirements of the related international and national regulations, so that a strategy for establishing a green and sustainable ship-recycling industry could be proposed, as a stepping stone toward the ratification of the Hong Kong Convention.

Besides the Hong Kong Convention, there are some other international regulations related to ship recycling including the United Nations Environment Programme’s (UNEP) Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal 1989 [12], the European Union’s Ship-recycling Regulation (EU SRR) 2013 [13], and the International Labour Organization’s (ILO) Safety and Health in Ship-breaking: Guidelines for Asian Countries and Turkey [14]. At the national level, the Indonesian regulations governing ship-recycling activities are National Law No. 17—2008 on Shipping [15], Government Regulation No. 21—2010 on the Protection of Maritime Environment [16], Regulation of the Ministry of Transport Republic of Indonesia No. PM 29—2014 on the Prevention of Maritime Environmental Pollution [17], and Government Regulation No. 101—2014 on the Treatment of Dangerous and Poisonous Waste [18].

2. Methodology

A gap analysis was conducted through a comparative study on the requirements of the national and international regulations related to ship recycling and existing ship-breaking practices in Indonesia. Three approaches were adopted in the study, namely, a literature review, discussion, and field visit. Before the study, the specific requirements of each related regulation were reviewed. Ship-breaking practices were also reviewed, with information gathered concerning how the ships were purchased and transported for recycling, ship dismantling, sorting of ship parts and components, collection and transportation of scraps and waste for reprocessing and treatment, etc. The impact of ship-recycling activities on human health, and safety, and the environment were also investigated. To establish a benchmark, reviews of efforts from the world’s leading ship-recycling countries in achieving international approval were carried out. Results of the gap analysis were used to propose a strategy toward establishing a green and sustainable ship-recycling industry in Indonesia and ratifying the Hong Kong Convention.

3. Benchmark from the World's Leading Ship-Recycling Countries

We evaluated the existing literature to establish a ship-recycling benchmark that would support the gap analysis. This review focused on how the world's major ship-recycling countries developed their ship-recycling industry and organized their regulations towards achieving economically sustainable ship-recycling practices.

3.1. Bangladesh

Ship-recycling in Bangladesh makes an important contribution to the country's growing economy, industry, and infrastructure, but as Rahman [19] suggested, it came at the cost of damaging the environment and the health of workers. Since Bangladesh does not have a source of iron ore, ship scraps became the main source of raw material for its steel and iron industry. The centre of Bangladesh's ship-breaking industry is mainly located in Sirakund, north of Chittagong, on the Bay of Bengal. It was reported by Das and Shahin [20] that almost 60% of raw materials for approximately 350 local steel industries were supplied from ship-recycling activities. The annual turnover of around 125 ship-recycling yards in Bangladesh was about USD 2.4 billion. To improve current ship-recycling practices, the government planned to form a ship-recycling board as a one-stop service for ship-recycling matters. Furthermore, the Bangladesh Ship-breaking and Ship Recycler's Association (BSBRA) was formed, which releases information related to ship-recycling activities in Bangladesh annually, so that any deviation from the available standards can be monitored and reported. To govern the ship-recycling industry, Alam and Faruque [21] reported that Bangladesh has The Ship-Breaking and Ship-recycling Rules 2011, and the ship-recycling industry must possess an environmental clearance certificate from the Department of the Environment in the Ministry of Forest and Environment, as a proof of its environmentally sound management. The Ministry of Industries of Bangladesh has declared its intention to ratify the Hong Kong Convention by 2023. Due to the government's efforts to establish an environmentally friendly ship-recycling industry, Mikelis [22] reported that one yard had been awarded the Hong Kong Convention Certificate, and that more will follow. However, a study by Gunbeyaz et al. [23], which investigated occupational training in the ship-recycling industry in Bangladesh, concluded that current occupational training in Bangladesh does not meet international standards; therefore, a proper training programme needs to be developed immediately.

3.2. India

In terms of tonnage, approximately 35% of global ship recycling is carried out in India [24], and around 90% of that takes place in Alang-Sosiya, Gujarat, using the beaching method. The location has been developed by the Gujarat Maritime Board (GMB) since 1982 and claims to be a safe ship-recycling zone operated cost-effectively. A comprehensive regulation on ship-recycling activities and the use of the facilities was first published in 1994 by the Gujarat Maritime Board and has been renewed from time to time; the latest one was published in 2015. The Gujarat Maritime Board (Conditions and Procedures for Granting Permission for Utilizing Ship-recycling Plots) Regulation, 2015, grants permission to use the plot for ship recycling, and obtain their permissions, licenses, authorizations, etc., under the relevant acts and rules/regulations under the State as well as Central Laws. As Loicq [25] reported, concerning the environment and working conditions, India has implemented the Ship-recycling Code 2013. GMB requires all ship-recycling yards to comply with the code. As a result, Jain [26] reported that in 2018, almost 50% of yards in Alang-Sosiya were certified under the Hong Kong Convention.

3.3. Pakistan

Pakistan is the world's fifth-largest ship-recycling centre in terms of number of ships scrapped, and fourth-largest based on tonnage [27]. Its ship-breaking yards are located in Gadani, on the Arabian Gulf, 50 km west of Karachi. The majority of plots are rented from private landlords, and the remainder are owned by the Balochistan Development Authority

(BDA). Like in India and Bangladesh, the beaching method is used to bring the ships ashore. The NGO Shipbreaking Platform [28] stated that approximately 5000–20,000 workers were employed in the industry, and most are migrant workers from the poorest parts of Pakistan. Ahmed and Siddiqui [29] reported that its around 70% of the ship scrap steel was sent to re-rolling mills in Karachi, and around 95% of the revenue of the industry came from the sale of ship scrap steel. Iqbal and Heidegger [30] explained that the regulations related to ship-recycling activities include The Balochistan Ship Breaking Industry Rules, which authorizes the BDA to lease plots for ship-breaking; the Hazardous Substances Rules, which protect the environment; and the Act for Occupational Safety and Health at Work Place, which addresses occupational health and safety. To date, there is no information that any ship-breaking yard in Pakistan has been awarded a Hong Kong Convention certificate.

3.4. Turkey

Turkey operates the largest ship-recycling industry among OECD members, and is the world's 12th-largest steel-producing country. The European Commission [31] reported that the steel industry is dependent on the supply of scrap iron, around 2% of which comes from ship-recycling yards at Aliğa, in the Aegean Region of west Turkey. Unlike ship-recycling yards in South Asia, in Turkey the modified slipway recycling method is implemented. In this system, ships are dragged onto a concrete slipway that extends into the sea and the ship is cut from the bow into sections, which are then pulled to the onshore cutting area. Turkey is a member of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 1989, and as an OECD member country, Turkey can recycle ships without violating a restriction on export to non-OECD countries. The ship-recycling industry is regulated by the Ministry of Transport. Vardar [32] stated that there have been some important improvements in Turkey's ship-breaking industry since the Greenpeace report on the poor working environment and health conditions in 2002, including the establishment of a new National Regulation on Ship-breaking Yards Certification System and Waste Management Centre. Moreover, Neşer et al. [33] stated that there are regulations on labour health and working safety, hazardous chemicals, and control of hazardous wastes. Turkish yards are investigated by the Ministry of Labour for their occupational health conditions. A wide range of occupational illnesses and accidents are also monitored and regulated. For example, a study on hazardous noise exposure from ship-recycling activities conducted by Kurt et al. [34] described the limit values that were introduced by the regulations and identified the most hazardous tasks that require specific attention. Alper and Güçlüer [35] reported that Turkey is the 6th country to ratify the Hong Kong Convention. Jain reported that in 2018, seven of Turkey's ship-recycling yards had obtained a statement of compliance with the Hong Kong Convention. The practices implemented in Turkey for ship-recycling, together with their regulatory framework, have been recognized among the safest and most environmentally sound of the major ship-recycling countries. The EU ship-recycling facility list, which shows the approved safe and environmentally sound facilities, only includes Turkish yards from the major ship-recycling countries.

3.5. China

China was the world's 4th-largest ship-recycling nation. The Shipbreaking Platform NGO [36] reported that ship-recycling yards in China are concentrated in three locations: Along the Pearl River in Xinhui; around Shanghai; and in Dalian, North China. Ship-recycling activities began in the 1960s, mainly to break down local ships. Then, the industry grew throughout the 1980s and reached its peak in the mid-1990s, due to government tax incentives. However, the ship-recycling works were considered hazardous to the environment and workers' health. In response to the fact-finding visit of Greenpeace and the Basel Action Network (BAN) in 1998, the Chinese government implemented tight laws on environmental protection and became the greenest ship recycler concerning the handling of waste. The yards use pier-side and dry-docking methods instead of beaching. In addition,

Kundu [37] explained that since 1 January 2019, the recycling of foreign ships has been prohibited by the government, as part of its effort to restrict waste and pollution-producing industries and the import of hazardous wastes from abroad. The ship-recycling yards also joined the International Ship Recycler's Association (ISRA), which actively improves the standards among its members. The new policy ensured that the market moved to South Asia, especially India and Bangladesh. Now the ship-recycling yards in China fully rely on the domestic market. To compensate for this, the government subsidizes Chinese-flagged ships to be demolished in China in order to retain its ship-recycling industry. Linnenkoper [38] reported that China has six yards that have obtained Hong Kong Convention certification. Regarding the regulations, Zhao and Chang [39] reported that before China adopted the Hong Kong Convention, there were only two regulations specifically related to ship-recycling, i.e., the Regulations on the Administration of Prevention of Environmental Pollution by Ship-recycling, and the Provisions of the Ministry of Material Supplies on Work Safety and Environmental Protection of Ship-recycling. Due to the impact of the Hong Kong Convention, in 2011, measures for the Administration of Ship-recycling at Designated Sites were established by the Maritime Safety Administration. All the regulations are either administrative or ministerial rules, which have lower power than the law. Besides administrative regulations, there are industry standards concerning ship recycling, i.e., the Green Ship-recycling General Regulation.

3.6. Lessons Learned

After reviewing the available literature on the efforts of the world's leading ship-recycling countries toward a green and sustainable ship-recycling industry, some general lessons learned were identified and are presented in Table 1.

Table 1. Lessons learned from reviewing literature on world-leading ship-recycling countries.

| Country | Efforts Undertaken | Impacts on the Industry |
|-------------------|---|---|
| Bangladesh | <ul style="list-style-type: none"> – The government formed the Bangladesh Ship-breaking and Ship Recycler's Association (BSBRA) – The Ship Breaking and Ship-recycling Rules 2011 – Environmental clearance certificate | <ul style="list-style-type: none"> – One yard has been awarded Hong Kong Convention certificate, and more should follow – The current occupational training does not meet international standards |
| India | <ul style="list-style-type: none"> – Establishment of the Gujarat Maritime Board (GMB) in 1982 – The Gujarat Maritime Board (Conditions and Procedures for Granting Permission for Utilizing Ship-recycling Plots) Regulation, 2015 – The Ship-recycling Code 2013 | <ul style="list-style-type: none"> – Nearly 50% of yards in Alang-Sosiya have been certified for the Hong Kong Convention |
| Pakistan | <ul style="list-style-type: none"> – The Balochistan Ship Breaking Industry Rules – Hazardous Substances Rules – Act for Occupational Safety and Health at the Work Place | <ul style="list-style-type: none"> – No information on any ship-recycling yard that has obtained a Hong Kong Convention certificate |
| Turkey | <ul style="list-style-type: none"> – Implemented the 'modified slipway recycling' method (also known as landing method) – Became a member of the Basel Convention – Became an OECD member – National Regulation on Ship-breaking, Yards Certification System, and Waste Management Centre – Regulations on Labour Health and Working Safety, Hazardous Chemicals, and Control of Hazardous Wastes – Has ratified Hong Kong Convention | <ul style="list-style-type: none"> – 7 of Turkey's ship-recycling yards have obtained a statement of compliance with the Hong Kong Convention – Turkish yards were included in the EU's ship-recycling facility list. |

Table 1. Cont.

| Country | Efforts Undertaken | Impacts on the Industry |
|---------|--|--|
| China | <ul style="list-style-type: none"> – Government tax incentive – Use of pier-side and dry-docking methods – Banned the recycling of foreign ships – Joined the International Ship Recycler’s Association (ISRA) – The government subsidizes the Chinese-flagged ships to be demolished in China – Regulations on the Administration of Prevention of Environmental Pollution by Ship-recycling – Provisions of Ministry of Material Supplies on Work Safety and Environmental Protection of Ship-recycling – Measures for the Administration of Ship-recycling at Designated Sites – Green Ship-recycling General Regulation | <ul style="list-style-type: none"> – All the regulations are in the form of administrative regulations or ministerial rules – Six yards have obtained the Hong Kong Convention certificate – The greenest ship recycler in terms of handling of waste |

4. Review of the International and National Regulations and Ship-Breaking Practices in Indonesia

We reviewed four international and four national regulations that govern ship-recycling and its related activities as the basis for investigating the disparity of regulations with existing ship-breaking practices in Indonesia. The international regulations reviewed were the International Convention for the Safe and Environmentally Sound Recycling of Ships 2009 (Hong Kong Convention), the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal 1989 (Basel Convention), European Union Ship-recycling Regulation (EU SRR) 2013, and International Labour Organization Safety and Health in Ship-breaking: Guidelines for Asian Countries and Turkey. The national regulations that were reviewed include National Law No.17—2008 on Shipping, Government Regulation No. 21—2010 on the Protection of the Maritime Environment, Regulation of the Ministry of Transport Republic of Indonesia No. PM 29—2014 on the Prevention of Maritime Environmental Pollution, and Government Regulation No. 101—2014 on the Treatment of Hazardous and Toxic Wastes.

4.1. International Regulations

4.1.1. Hong Kong Convention

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships (Hong Kong Convention) was adopted in May 2009. The Hong Kong Convention aims to ensure that the end of a ship’s life cycle does not pose any unnecessary risk to human health and safety, nor to the environment. The convention covers the complete life-cycle of the ship (the design, construction, operation, and preparation of ships to facilitate safe and environmentally sound recycling), and the operation of ship recycling facilities in a safe and environmentally sound manner [40]. It is intended to be a legally binding instrument that addresses the environment, occupational health, and safety risks related to ship recycling. The convention covers the requirements for the preparation of the ship for recycling, including all of the information needed before the ship is recycled at the recycling facility in terms of survey and certification, as well as the ship-recycling facility and ship-recycling plan, which are ship-specific. In particular, requirements for ship-recycling facilities include controls and authorization of ship recycling, the establishment of management systems, procedures, and techniques that do not pose health risks to the workers or the population in the vicinity, and acceptance of only those ships that comply with the Hong Kong Convention. However, it does not describe how further processing or disposal of the hazardous material should be carried out.

The convention provides some guidelines to meet the requirements, including the Guidelines for the Development of the Ship-recycling Plan [41], Guidelines for the Develop-

ment of the Inventory of Hazardous Materials [42], Guidelines for Safe and Environmentally Sound Ship-recycling [43], Guidelines for the Survey and Certification of Ships under the Hong Kong Convention [44], Guidelines For the Authorization of Ship-recycling Facilities [45], and Guidelines for the Inspection of Ships under the Hong Kong Convention [46]. The convention is only applied to merchant ships of at least 500 gross tonnes (GT), and it also regulates the ship-recycling state, ship-recycling facility, ship owner, and flag state.

The Hong Kong Convention also introduces a regulation on the Inventory of Hazardous Materials, which makes it mandatory for ships to carry the related documentation onboard five years after the convention enters into force, and this includes ships that are sent for recycling. The regulation requires that ships should be surveyed to verify that the hazardous materials on board are documented. The survey will be renewed periodically until the ship is sent for recycling. The convention also provides detailed information on the hazardous materials that must not be installed or used during the construction or repair of the ship.

The Hong Kong Convention will enter into force 24 months after being ratified by at least 15 countries and when the fleets of the ratifying countries account for at least 40% of the world's fleet, and the recycling capacities of these countries represents at least 3% of their fleets. Mikelis reported that by the end of 2019, 15 countries had become contracting states of the convention, namely, Norway, Republic of Congo, France, Belgium, Panama, Denmark, Turkey, The Netherlands, The Republic of Serbia, Japan, Estonia, Malta, Germany, Ghana, and India. The fleets of these countries represent 30.1% of the world's fleet.

In support of the Hong Kong Convention, the International Chamber of Shipping (ICS) [47] has led an inter-industry working group to adopt Guidelines on Transitional Measures for Shipowners to encourage ship-owners to recycle their end-of-life ships at the facilities that comply with the Hong Kong Convention.

4.1.2. Basel Convention

The Basel Convention on the Control of Transboundary Movement of Hazardous Waste and their Disposal (Basel Convention) is part of the United Nations Environmental Program (UNEP). It was adopted in 1989 and came into force in 1992. The main objective of the Basel Convention was to control the movement of hazardous waste from developed countries to developing countries. The legal aspects of the convention [48] regard end-of-life ships as hazardous waste because of their toxic components such as asbestos, lead, and mercury. At the time, Gulbrandsen [48] stated that it was the only international treaty that applies to ship recycling. It has been ratified by more than 180 countries.

The International Pollutants Elimination Network (IPEN) and Basel Action Network (BAN) [49] reported that a group of delegates from developing countries created the Ban Amendment in 1995, which prohibits the export of hazardous waste from more developed to less developed countries. The amendment entered into force at the international level on 5 December 2019. The Basel Convention reported that the convention, including the Ban Amendment, was adopted by all member states of the Organization of Economic Cooperation and Development (OECD) and the European Union (EU). The export of hazardous waste from the EU to developing countries is thus prohibited.

With regard to ship-recycling issues, in 2003, the Basel Convention published Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships [50] in order to enable a ship-dismantling facility to attain Environmentally Sound Management (ESM) by providing information and recommendations on practices related to health, safety, and the environment. The guidelines provide recommendations regarding the implementation of the advised practices and on monitoring and the verification of performance, and they cover all elements of the process including the environmental management plan, ship to be dismantled, and the ship-recycling facility. With regard to the environmental management plan, to attain Environmentally Sound Management (ESM), the ship-recycling facility must establish an Environmental Management Plan (EMP), which includes the assessment of potential environmental impacts (EIA), formulation

of potential preventative measures, and an Environmental Management System (EMS). Considering the ship to be dismantled, some procedures should be implemented such as an inventory of hazardous wastes, removal of hazardous materials, securing the vessel for safe access and working conditions, and removal of ship equipment. Finally, in terms of the ship-recycling facility, some supporting facilities should be made available for the containment of hazardous materials including workstations in which to dismantle ship parts, and storage facilities for fully processed equipment and materials, and there should be disposal facilities in close proximity.

4.1.3. European Union (EU) Ship-Recycling Regulation

The EU Ship-recycling Regulation (EU SRR) No 1257/2013 was adopted in 2013 and came into force on 30 December 2013, and the latest iteration came into force on 31 December 2018. Van Werven [51] noted that the objective of the regulation is to reduce the negative impacts of ship-recycling activities, particularly from ships flying the flag of EU member states, since the regulation is applied only to commercial vessels above 500 GT flying an EU member flag, and other ships calling at EU ports or anchorages. The regulation brings forward the requirements of the Hong Kong Convention and some higher standards are also included, for example, the beaching method is not allowed, and downstream toxic waste management and labour rights issues are addressed.

On 19 December 2016, the EU established the European List of Approved Ship-recycling Facilities, which comprises ship-recycling facilities worldwide and is periodically updated. Starting from 31 December 2018, EU-flagged end-of-life commercial ships above 500 GT could only be recycled in the listed safe and environmentally sound ship recycling facilities.

However, van Werven explained that when the EU SSR came into force in 2018, it included the resolution of the IMO's Marine Environmental Protection Committee on Inventory of Hazardous Materials (IHM), which is part of the Hong Kong Convention. van Werven went on to explain that new ships with a building contract signed after 31 December 2018 must have an IHM certificate in its specifications, and for ships in operation flying an EU member state flag and ships calling at a port or anchorage of an EU member state, a certified IHM would be required after 31 December 2020.

4.1.4. International Labour Organization (ILO) Safety and Health in Ship Breaking: Guidelines for Asian Countries and Turkey

The Safety and Health in Ship Breaking: Guidelines for Asian Countries and Turkey were approved for publication by the governing body of the International Labour Organization at its 289th session in March 2004. The objective of the guidelines is to assist ship breakers and authorities to implement the relevant ILO standards and codes of practice relating to occupational health and safety conditions in ship-breaking activities. They are not legally binding and do not replace national laws, regulations, or standards, serving only as guidance to those engaged in the relevant activities. The guidelines are in agreement with the IMO conventions, Basel Convention, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention, 1972, and Protocol, 1996), and the International Chamber of Shipping (ICS) Industry Code of Practice on Ship-recycling.

The guidelines consist of two elements: The national framework and the framework for safe ship-breaking operations. The national framework covers general responsibilities, duties and rights, the legal framework, occupational safety and health services, and the management, reporting, recording, and notification of work-related injuries and diseases, ill-health, and incidents. The safe ship-breaking operation element covers operational planning; general preventive and protective measures; management of hazardous substances; measures against physical hazards; measures against biological hazards; ergonomic and psychosocial hazards; safety requirements for tools, machines, and equipment; competence and training; personal protective equipment; contingency and emergency preparedness; special protection; and welfare.

4.2. National Regulations

4.2.1. National Law No.17—2008 on Shipping

National Law No.17—2008 on Shipping serves as a general provision covering all aspects of national shipping including water transportation, port affairs, maritime safety and security, and protection of the marine environment. It has 22 chapters, with 355 articles.

The issues of ship recycling are included in articles 123, 241, 242, and 329. The first article states that the protection of the maritime environment requires effort to prevent and combat environmental pollution sourced from activities related to shipping. It is further explained in article 123 that the protection of the maritime environment is related to port activities, ship operations, waste transportation, hazardous and toxic materials, waste disposal, and ship recycling. As a general regulation, the law does not mention any further detail of these issues. Article 241 only states that ship recycling must comply with the requirements of maritime environmental protection, which together with the locations for ship recycling, are regulated by ministerial regulation. Article 242 states that the provisions for maritime environmental protection for ship-recycling activities are regulated by ministerial regulation. Article 329 is the provision related to the legal consequences and liability for violations of article 241.

4.2.2. Government Regulation No. 21—2010 on the Protection of Maritime Environment

Government regulation No. 21—2010 on the Protection of Maritime Environment is complementary to the National Law No.17—2008 on Shipping. In this regulation, protection of the maritime environment is defined as any effort to prevent and combat pollution entering the maritime environment from activities related to shipping such as disposal of waste into waters and disposal from the ship or ship structure, except disposal that comes from the normal operation of a ship. Article 2, paragraph 3, states that, the protection of the maritime environment includes combatting pollution from ship recycling.

In article 34, the regulation appoints a designated minister to provide an information system on the protection of the maritime environment, including from disposal of waste into waters and ship recycling. The information system stores details of underwater structures, waste disposal locations, and ship-recycling locations. The details of article 34 are stated in article 35, within which paragraph 3 explains that the information on ship-recycling locations shall include the location of ship-recycling in ports and on the water. This statement is somewhat misleading, since no (or almost no) ship-recycling activity is carried out at port or on the water.

Environmental pollution from ships can be in the form of oil, toxic liquid, hazardous cargo, waste, garbage, air, ballast water, and any other hazardous material. Disposal of waste can only be carried out at appointed or recognized disposal facilities.

The regulation does not specifically govern the protection of the maritime environment from ship-recycling activities, but mostly from the operation of ships and port activities, even though it states that the regulation also applies to ship recycling.

4.2.3. Regulation of the Ministry of the Transport Republic of Indonesia No. PM29–2014 on the Prevention of Maritime Environmental Pollution

The ministerial Regulation of the Ministry of the Transport Republic of Indonesia No. PM29–2014 on the Prevention of Maritime Environmental Pollution was derived from the National Law No.17–2008 on Shipping, and Government regulation No. 21–2010 on the Protection of Maritime Environment. Oktaviany [52] explained that it covers all requirements related to the protection of the maritime environment, including those laid out in the international regulations, such as the International Convention for the Prevention of Pollution from Ships 1973, modified by the 1978 protocol (MARPOL 73/78); the International Convention on the Control of Harmful Anti-Fouling Systems on Ships (AFS Convention), the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention); and the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships 2009 (Hong Kong Convention).

Within this ministerial regulation, ship recycling is covered in Section 2 paragraph 4, articles 51–56. It states that ships with a gross tonnage of at least 500 GT that sail on international waters, and ship-recycling facilities, are required to meet the appropriate international regulations. Ships with a gross tonnage of 100 GT and above that sail in Indonesian waters, and ship-recycling facilities that operate in Indonesia, are required to meet this ministerial regulation.

Ships and recycling facilities that comply with the regulations are given a ship-recycling certificate and authorization for ship recycling. It is prohibited to use materials in ship-recycling processes that could might endanger health or damage the environment. Ships that undergo recycling must possess an Inventory of Hazardous Materials (IHM), which highlights the type, volume, and location of hazardous materials. The Inventory of Hazardous Materials should be prepared by the ship owner or ship-recycling facility and verified by the authorities. Article 63 paragraphs 15–19 explain the procedures for a ship-owner to request the international and national certificates on the Inventory of Hazardous Materials.

Before a ship being recycled, the owner must prepare certain documents related to oil and chemicals on board, safety to enter, safety for hot work to be undertaken, a ship-recycling plan, discharge of waste, and draining of liquid and ballast water. All documents are subject to inspection by the authority.

Ship recycling can only be carried out at the authorized ship-recycling facility, which prepares a ship-recycling plan for every ship to be recycled and is subject to inspection by the authorities. Upon completion, a ship-recycling report should be submitted to the authorities.

With regard to ship-recycling activities, the regulation is divided into two categories: Ships with a gross tonnage of at least 500 GT that sail in international waters, and ships with a gross tonnage of at least 100 GT that sail in Indonesian waters. For the first category, the regulation requires ship-recycling to meet international standards, but it does not specify which international regulations should be met. For ships above 100 GT, the ship-recycling facilities should meet the requirements of the national regulation, which comprehensively covers the safety and environmental aspects of ship recycling.

4.2.4. Government Regulation No. 101—2014 on the Treatment of Hazardous and Toxic Wastes

Government Regulation No. 101—2014 on the Treatment of Hazardous and Toxic Wastes covers the definition and categorization of hazardous and toxic wastes; requirements for reduction, storage, collection, transportation, utilization, treatment, dumping, and trans-border transport of hazardous and toxic waste; hazardous and toxic waste exceptions; combating and recovering of environmental pollution; the emergency system for hazardous and toxic waste management; and administrative sanctions.

According to this regulation, hazardous and toxic waste related to ship-recycling includes contaminated scrap metal, electronics waste, leftover fuel and lubrication oil, paint, and leftover hazardous or toxic cargo.

The procedures for the treatment of hazardous and toxic wastes in the ship-recycling facility include its identification, sorting, storage and containment, and handover to waste treatment facilities.

The regulation does not specifically govern the handling and treatment of hazardous and toxic waste from ship-recycling activities, while many of its requirements are related to them, including sorting, containment, transportation, treatment and future utilization; ship recycling is included in the latter category.

4.3. A Review of Ship-Recycling Practices in Indonesia

Field visits were conducted in 2019 at the following four ship-recycling locations: Bangkalan, Madura; Cilincing, North Jakarta; Tanjung Uncang, Batam; and Bojonegara, Banten, (Figure 1). It was concluded that ship-breaking yards in Bangkalan, Cilincing, and most of the yards in Tanjung Uncang, which are categorized as conventional ship-breaking

yards, were using a simple and environmentally unfriendly method. These sites typically occupy 1–2 km of shoreline. At the repair yards visited in Tanjung Uncang and Bojonegara, a rather modern and more environmentally friendly method was being implemented. The information gathered from field visits corresponded to the report paper published by the Ministry of Transport [53]. None of the yards visited are legally registered as a ship-recycling yard, even though most of them started business in the early 1990s as “general traders”. Thus, they do not comply with the requirements of national or international regulations. Based on informal interviews with the yard-owners during the visit, it was indicated that the reasons for the yards not being legally registered, nor complying with the regulations, are because the registration procedures are complicated, the government seems concerned only about tax, there is no incentive from the government for the yards to meet the requirements of existing regulations; there was no perceived benefit of complying to the regulations considering the costs involved.



Figure 1. Locations of the ship-breaking yards visited.

The conventional yards usually purchased ships through brokers who obtained them from all over Indonesia. Ships were usually either towed or transported using their own power to arrive at yards, after which they were beached and pulled ashore gradually utilizing tidal action and an onshore winch. Ship parts were lifted and moved to dry land using crawler cranes, where further breaking processes were carried out. After going through some necessary cleaning processes, the ships' machinery and equipment were dismantled and the structures were cut part-by-part from the top to the bottom, and from the bow sternward using oxy-acetylene flame cutters. Many activities were carried out on dry land involving people who worked for the yards to sort the equipment and components gleaned; to clean pipes, sections, and plates; and to strip cables, etc. People from the surrounding area also gathered some of the leftover materials from the ship breaking. There was little information obtained on how the waste generated by these activities was handled and treated. Some yard-owners admitted that the waste was entrusted to third parties. Based on field observations, it could be concluded that the ship-recycling activities in these yards have little regard to the safety of neither workers nor the environment.

A rather environmentally friendly approach was being adopted at some ship-repair yards that carried out ship-breaking activities. In general, the ship-breaking processes were as follows: Instead of beaching, ships were berthed to slipways using airbags, or dry-docked (usually using floating docks) utilizing the same techniques as those adopted for ship repairing. After the ships were cleaned of flammable and hazardous materials, their machinery and equipment were taken and the structures were cut into blocks, in the area known as the primary cutting zone. The blocks were then moved (usually using

crawler cranes) to the secondary cutting zone further back to be cut into smaller pieces, and separated between those that could be directly reused and those considered scraps. Plates and sections that could be reused were cleaned and stacked, while the scraps were piled up in a container, waiting to be collected by the owner. Bulk waste and hazardous materials were piled up in special containers waiting to be collected by a third party for treatment, but there was no record on the type or quantity of waste that had been collected, nor where and how it was treated. When field visits were conducted, the grime of the rust and paint and puddles of oil were still found both in the primary and secondary cutting zones, but very little was found on the surface of the yards' waterfronts. Unlike the conventional ship-breaking yards, in these yards, the ships were not purchased by the yards, but were brought in by the owners to be dismantled and broken down, and thus all the parts, machinery, equipment, and even the scraps belonged to the owners. The yards received the breaking fee and were responsible for handling the waste. It was noted that the number of ships that have been recycled by the ship-repair yards was much lower than the conventional ship-breaking yards, mainly because of the higher working costs and the more complex administration procedures.

In most of the ship-breaking yards, basic tools were used to dismantle the ships, and proper working procedures concerning the safety and the health of the workers were not available. Gas cylinders were not stored properly, and gas hoses were not organized, while crawler cranes and forklift trucks were moving among piles of ship parts and scraps. Workers did not wear appropriate personal protective equipment (PPE) and were exposed to fumes, toxic gas, and hazardous materials; therefore, they were vulnerable to accidents and sickness. The ship-breaking activities were hostile to the community and the environment, since they were located very close to residential areas, and the works were conducted on the shore, which means pollutants and hazardous waste easily flowed into the sea. Samples taken from around the ship-breaking yards in Cilincing revealed that the average content of lead (Pb) in the water was 0.0067 ppm and in the sediment was 0.75 ppm; mercury (Hg) content in the water was 0.0015 ppm and in the sediment was 0.78 ppm; cadmium (Cd) content in the water was 0.0017 ppm; and in the sediment was 0.625 ppm. With regard to the seawater quality standards published by the Ministry of Environment and Forestry [54], the level of contamination from heavy metals in the water were still under the allowed limits, but the level of contamination in the sediment was very high, even though there are no national standards available for sediment pollution. Based on the information gathered through interviews with local fishermen, the diversity and amount of fish within a 4 km radius from the shore has declined drastically over the last 5 years.

4.4. Gap Analysis

A gap analysis was conducted by comparing the requirements of the international and national regulations with current ship-breaking practices in Indonesia. Based on the information collected both from field visits and secondary sources, almost all of the yards were unfamiliar with the requirements of the regulations and regarded them as complicated, because there was a lack of dissemination by the authorities. Furthermore, proper working procedures that consider the health and safety of workers and the environment were considered too costly and impractical, waste was not handled and treated properly, only combustible materials were cleared before ship-breaking, and only ships to be recycled at the repair yards were inspected by the authorities, who mainly checked their legal documents only, and recycling plans and procedures were seldom prepared by the yards. All of the ships recycled in both the conventional yards and ship-repair yards did not possess an IHM; some yards mistook the ownership of a clearance certificate for a ready-for-ship-recycling certificate, claiming to be authorized to conduct ship-recycling activities. Concerning the national regulations, only the Regulation of the Ministry of Transport No. PM 29—2014 comprehensively covers ship-recycling activities, especially for ships of at least 100 GT that sail in Indonesian waters. For the treatment of hazardous and toxic

waste, Government Regulation No. 101—2014 covers wide-ranging aspects, including ship-recycling activities, but it does not cover the handling and treatment of hazardous and toxic waste coming from ship-recycling activities. A summary of the gap analysis is presented in Table 2, and the results of the gap analysis are presented in Table 3.

Table 2. Gap analysis summary.

| International Regulation | National Regulation Gap Analysis Summary | Ship-Breaking Practice Gap Analysis Summary |
|--|---|---|
| <p>Hong Kong Convention:</p> <ul style="list-style-type: none"> – Control complete life cycle of the ship. – Covers requirements for the preparation of ship recycling, including ships and ship recycling facilities. – Control and authorization of ship-recycling, including management system, and health risk control. – Accepts ships that comply with the convention or meet the requirements of the convention. – Ensures safe and environmentally sound removal of any hazardous material, – Provides worker safety and training – Provides some complementary guidelines. – Includes regulation on IHM | <p>National Law No. 17–2008:</p> <ul style="list-style-type: none"> – Serves as general provision of all aspects of national shipping. – Ship-recycling must comply with the requirements of maritime environmental protection. – Provides the legal consequences and liability for violations of law. | |
| <p>Basel Convention:</p> <ul style="list-style-type: none"> – Controls the movement of hazardous waste. – Regards end-of-life ships as hazardous waste. – Provides guidelines for the ESM of the full and partial dismantling of ships – EMP of the ship to be dismantled, and the ship-recycling facility. – Assessment of potential environmental impacts. – Inventory of hazardous waste, and removal of hazardous materials. – Securing the vessel for safe access and safe working conditions, and removal of ship equipment. – Provision of facilities for containment of hazardous materials, workstation for dismantling ship parts, storage facilities for fully processed equipment and materials, and proximity to proper disposal facilities. | <p>Government Regulation No. 21–2010:</p> <ul style="list-style-type: none"> – Provides information on waste disposal location and ship-recycling location. – Disposal of waste can only be carried out at appointed locations. | <ul style="list-style-type: none"> – The beaching method is used in all conventional ship-breaking yards. – Slipway and dry-docking are used in some ship-repair yards. – Combustible materials are cleaned before the ships are recycled. – Ship-breaking yards are not legally registered. – Basic tools are used. – No proper working procedure concerning the safety or health of workers. – In most ship-breaking yards, tools and equipment are not well organized. – No waste treatment information is available. – No regard for the safety of the workers and environment, except in a few ship-repair yards. |
| <p>EU SRR:</p> <ul style="list-style-type: none"> – Adopts all requirements of HKC including IHM. – Beaching method is banned. – Ensures downstream toxic waste management and labour rights. | <p>No. PM 29–2014:</p> <ul style="list-style-type: none"> – Adopts all IMO regulations such as MARPOL 73/78, AFS Convention, BWM Convention, and Hong Kong Convention. – Ships 500 GT and above, and their recycling facilities, shall follow international regulations. – Ships 100 GT and above, and their recycling facilities shall comply with this regulation. – Prohibits use of materials that might endanger human health or the environment. – Ships that undergo recycling must possess an IHM. – Before being recycled, ships must prepare related documents. – Recycling can only be carried out at the authorized facility. – The report must be submitted upon completion of the recycling process. | |

Table 2. Cont.

| International Regulation | National Regulation Gap Analysis Summary | Ship-Breaking Practice Gap Analysis Summary |
|---|---|---|
| ILO Guidelines: | Government Regulation No. 101–2014 | |
| <ul style="list-style-type: none"> – Provide operational planning, general preventive and protective measures, and management of hazardous substances. – Measures against physical, biological, ergonomic, and psychosocial hazards. – Safety requirements for tools, equipment, and competency. – Personal protective equipment. – Contingency plans and emergency procedures. – Special protection and welfare. | <ul style="list-style-type: none"> – Identify hazardous and toxic waste. – Sort hazardous and toxic waste from other waste. – Storage and containment of hazardous and toxic waste. – Record the type and amount of hazardous and toxic waste collected. – Handover hazardous and toxic waste to waste-treatment facilities. | |

Table 3. Results of the gap analysis.

| Regulations | Ship Recycling |
|---|--|
| <ul style="list-style-type: none"> – National Law No.17–2008 does not give any specific guidance on ship-recycling activities, and the requirements are general. It does provide the legal consequences and liability for the violations of this law. – Government Regulation No. 21–2010 only gives guidance on the provision of information on the location of waste disposal and ship recycling points. – Regulation of the Ministry of Transport No. PM 29–2014 covers most IMO regulations including HKC. It provides comprehensive requirements for ships above 100 GT, and their recycling facilities are included, but there is no requirement regarding the disposal and treatment of waste from ship-recycling facilities. – Government Regulation No. 101–2014 covers wide-ranging aspects of the treatment of hazardous and toxic wastes including those from ship-recycling activities, but it does not specifically govern the handling and treatment of hazardous and toxic wastes from ship-recycling activities. | <ul style="list-style-type: none"> – The ship berthing method in most ship-breaking yards is not acceptable according to the regulations. – Lack of attention to the safety of workers or possible damage to the environment. – Lack of proper working procedures. – Lack of proper working tools and equipment. – Lack of information on the treatment of wastes. – Lack of yard arrangement and working organization. – Lack of regulations dissemination by the authorities. |

5. Results and Discussion

The main issues addressed by the international regulations that have been reviewed regard the protection of human health and safety and protection of the environment; among these regulations, the Hong Kong Convention and EU Ship-recycling Regulation are the most comprehensive. They cover the life cycle of a ship. With regard to ship recycling, the Hong Kong Convention includes almost all aspects of recycling, but it does not regulate how the waste should be handled and treated. The EU Ship-recycling Regulation is more focused on the recycling of ships flying an EU member state flag, and ships calling at EU ports or anchorages. The regulation adopts the requirements of the Hong Kong Convention and also has higher standards for certain matters such as downstream toxic waste management and labour rights. The Basel Convention is more focussed on controlling the movement

of hazardous waste, particularly from developed countries to developing countries. The Basel Convention also published Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships and provides information and recommendations on procedures, processes, and practices related to health, safety, and the environment. The Safety and Health in Ship-breaking: Guidelines for Asian countries and Turkey guides ship-breakers and authorities to implement the relevant ILO standards and codes of practice on occupational safety and health and working conditions in ship-breaking activities.

With regard to the national regulations, only the Regulation of the Ministry of the Transport Republic of Indonesia No. PM 29—2014 on the Prevention of Maritime Environmental Pollution has comprehensive requirements for ship-recycling concerning the inspection and preparation of ships for recycling, procedures, equipment, materials used by the ship-recycling facility, recycling plan, and reporting procedures when ship-recycling has been performed. Government regulation No. 101—2014 on the treatment of Hazardous and Toxic Wastes only sets out requirements on the treatment of hazardous and toxic waste, including waste generated by ship-recycling activities, but does not address how to handle and treat the waste. The other two regulations we reviewed do not contain detailed requirements on the process of ship-recycling.

Results of the gap analysis based on the matching of the ship-breaking practices in Indonesia to the requirements of the international and national regulations showed that most ship-breaking processes carried out by conventional yards were far from meeting the requirements of the existing regulations. The ship recycling carried out by ship-repair yards, although more orderly and environmentally friendly, still did not fully conform to the requirements of the international and national regulations, especially concerning the handling and treatment of waste. Yards were reluctant to register as ship-recycling yards and adopt the requirements of the regulations because they did not see the benefit of doing so; instead, they considered them as costly and complicated. This was mainly due to the lack of effort by the authorities to disseminate the regulations.

To ratify the Hong Kong Convention and gain international recognition in the ship-recycling industry in Indonesia, the government needs to increase the willingness of the ship-recycling yards to adopt the requirements of the regulations and see the benefits of doing so. This could be achieved by intensively disseminating the regulations, providing training, and offering incentives, with the goal being that gradually yards will meet the requirements of the regulations and comply with the Hong Kong Convention.

To avoid conflict and misinterpretation, the existing national regulations related to ship-recycling activities need to be integrated and synchronized.

6. Conclusions

A gap analysis was conducted by reviewing the development of the ship-recycling industry in five of the world's leading ship-recycling countries, to establish a benchmark and compare the requirements of the international and national regulations with the existing ship-breaking practices in Indonesia.

We concluded that the Hong Kong Convention, and Basel Convention are the core of the international regulations that govern ship-recycling activities, while the EU Ship-recycling Regulation and ILO Safety and Health in the Ship-breaking Guidelines act as supporting regulations. At the national level, only the Regulation of the Ministry of the Transport Republic of Indonesia No. PM 29—2014 on the Prevention of Maritime Environmental Pollution has comprehensive requirements related to ship recycling.

The ship-recycling industry in Indonesia consists of conventional ship-breaking yards that use simple and environmentally unfriendly methods, and ship-repair yards, which conduct ship-breaking using a rather modern and more environmentally friendly method. Nevertheless, none of these yards are officially registered as a ship-recycling yard.

Based on the results of the gap analysis, we conclude that no ship-recycling yard in Indonesia conformed to international or national regulations; therefore, in conjunction with

the government's plan to ratify the Hong Kong Convention, great efforts are needed to develop the industry in order to gradually meet the requirements set out by the regulations.

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