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Effects of Global Factors on Sustainable Ship Recycling

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Abstract **-This paper examines the factors influencing ship recycling industry and their effect on the sustainability of the industry. It focuses on operations, which include current working practices of ship breaking facilities in global locations and regulations that govern these procedures. The objective of this study is to analyse how far the ship recycling operations stay within the existing regulations and whether any gaps exist, how best the future regulations and operational procedures can be improved in order to narrow down the existing gaps so that the sustainability of industry can be achieved. Major ship recycling yards in Asia are reviewed in this paper since they contribute to almost all the ship recycling currently take place globally.**

Keywords – Ship recycling, Basel convention, Hong Kong convention, Ship recycling yards.

I. INTRODUCTION

The ship is a mobile structure consisting mainly of steel and has a definite life cycle. At the end of its productive life span it needs to be responsibly broken up so that the steel scrap could be reused in new steel production, or the broken up parts could be reused in a different industry. It is essential for the renewal of the shipping fleet [1]. Amongst the different alternatives for the disposing of a vessel at the end of its operational life, recycling, which ensures the reuse of its components such as steel, is considered the most environmentally friendly way of disposing of an old ship, as compared to its sinking or abandonment. [2]

In different global locations, ship recycling is being carried out, involving different methods, using best available resources in that particular country, contributing immensely to local economies and providing a sustainable solution to world's aging ships [3].

There are many external factors which influence the sustainability of ship recycling and much can be done globally to steer it towards the sustainable industry. Amongst them, recycling operations, international and local regulations which govern those operations, pollution resulting from a particular operation, health and safety issues in the process are the leading factors for consideration.

In the following section operations and regulations pertaining to ship recycling are reviewed and analysed. Pollution, created by the ship recycling industry is briefly introduced in this paper, due to its immense impact on global well-being. It will require a study on its own in the future.

II. LITERATURE REVIEW

A. Regulations

An attempt to regulate ship recycling has been a result of the struggle between the shipping industry and civil society [4]. The first international regulation which addressed the disposal of hazardous waste from ships was adopted in 1989 as Basel convention and came into force in 1992 [5]. It applies to all types of ships when they are waste and the transboundary movement of ships that are waste. The regulation does not clearly define how the provisions in the Basel Convention could be practically applied once the dismantling process has commenced [6]. The standards, code of practices and guidelines of the International Labour Organization (ILO) for ship recycling were adopted in Thailand in 2003 and approved by the governing body of the ILO in 2004 [7]. These guidelines place responsibilities, duties and guidance upon the national legal framework and the integrity of the competent authority of the country where recycling takes place. [7].

Due to the pressing need of a comprehensive set of regulations to control the complete process of ship recycling, the International Maritime Organization (IMO) with inputs from its member states, and in corporation with the ILO and the parties to the Basel Convention subsequently developed the text of the Hong Kong Convention. (2009). Though it was adopted by IMO in 2009, it is yet to be ratified. This Convention specifies the planning of vessel's recycling at the building stage itself. Ships will be required to have an initial survey to verify the inventory of hazardous materials, additional surveys during the life of the ship, and a final survey prior to recycling [8]. This convention defines the duties of flag state which is the country whose flag the ship is entitled to fly and the recycling state, which is the country where the identified ship recycling facility is located [9]. However, in the absence of proper incentives and support mechanisms provided by the Convention to upgrade recycling facilities, it is unlikely that major recycling states would be enthusiastic to sign the Convention [10].

The Council of the European Union (EU) adopted ship recycling regulations in 2013. The objective of these Regulations is to reduce the negative impacts linked to the recycling of ships flying the flag of Member States of the Union. This regulation, comes into effect in 2018, bringing forward the requirements of the Hong Kong Convention, bringing its global entry into force. Seagoing vessels flying the flag of an EU Member State can be recycled only in a facility included in the European List of ship recycling facilities [11]. List of EU approved yard are attached in annex 1 of the appendices. However, it is interesting to note that some vessels owned by EU member states change their flag state to a less responsible flag at the time of handing over the vessel for recycling in order to avoid restrictions enforced by the original flag state [2]. Ways to plug this loophole are suggested in the recommendations of this paper.

National regulations of principal ship recycling states concentrate on workers' rights, but not specifically in recycling procedure [12], so unable to make a fair review on it.

B. Operation

One of the main factors that can influence sustainability in ship recycling is the operational procedure of recycling. There are three ship recycling methods in practice in different recycling locations. Beaching referred to breaking up a vessel at beach facility. This method is used in tidal plain countries of India, Bangladesh and Pakistan where three quarters of total recycled tonnage had been carried out in 2015 (2). (Annex II of appendices) Two major environmental impacts associated with beaching are, firstly, the use of a larger area for dismantling, affects both the local surrounding, environment and the society. Secondly, discharges and emissions to sea, ground and air cause pollution. The lack of containment to prevent toxins from entering the environment is a major concern [13]. However, it provides employment to a large unskilled population, while getting rid of end of life tonnage economically [14].

The second method, modified slipway recycling, is used in areas with lower tidal ranges. It involves dragging a ship onto a concrete slipway, which extends into the sea [15]. This form of recycling takes place in Turkey. Vessels are pulled ashore before they are cut at the bow and 600–800 tonne sections, are pulled onto an onshore cutting area. Smaller sections and equipment are later removed by cranes. As the shore ground contains densely packed soil, vehicles and cranes can operate close to the vessel [16]. Since the recycling yards are manned with skilled labour, health and safety hazards are reduced, however solid and liquid waste generation and air pollution exist in these yards [16].

The third method, is to carry out breaking up of a ship in a dry dock or specialized sail-in berth, as practiced in Chinese facilities of Pearl River Delta and Yangtze River Delta [17]. or dismantling by the quay and subsequent scrapping on impermeable floors with effective drainage systems as in Denmark Rolshøjvej facility [18].

Turkish yards, which practice modified slipway method of ship breaking stands out over the beaching method as its process reduces sea and ground pollution, further it employs a skilled workforce and heavy lift equipment thereby improving the quality of work [15].

Chinese facilities, after having invested in expensive green recycling yards, hoping to attract demand from all over the world once international environmental regulations were enforced are closer to breaking point [19]. Overcapacity in Chinese shipbreaking yards and anticipation of the strict regulatory framework, have placed China in this unfavourable situation [19].

Global steel price saw a regular decline for last eight years, from 750 United States Dollars (USD) /Tonne to 395 USD/Tonne, [20] which has a bearing on the price of scrap steel, as scrap steel is used in the production of steel. When Indian subcontinent offers a ship owner 380 USD/Tonne of scrap steel China could offer 210USD/Tonne due to their higher overheads and surplus steel production [17].

For the last several years the Chinese government paid an additional 200 USD per light displacement tonne (LDT) incentive to Chinese ship owners who choose to recycle their vessels in Chinese yards [19]. The results show this model has been effective in reducing Chinese vessels beaching for recycling.

C. Pollution

Ship breaking yard originated pollution can adversely impact air, water and the soil. [7]. Dangerously high air pollution in the vicinity of ship breaking yards has been detected by a recent study, where the concentrations of toxic chemicals and persistent organic pollutants (POP) in the air were found to be above carcinogenic risk limits as set by the World Health Organization. [21]. Ship breaking is also a known asbestos exposure hazard, the results, obtained from shipbreakers in Taiwan, have shown higher rates of cancer overall, especially lung cancers [22]. There are numerous cases of water and ground pollution have been documented near shipbreaking yards of beaching and modified slipway locations [22]. Since pollution is a serious threat to the sustainable ship recycling operation, the author intends to research the subject in subsequent studies.

D. Planning

My intention of this paper was to first identify the factors that influence the sustainable ship recycling operation, then separate out the factors that will be reviewed in detail within the scope of this report. Factors such as pollution are only briefly introduced here since the topic needs comprehensive research, and will be reviewed in subsequent publications as a separate subject. Operational procedure of ship recycling in major global locations and the regulations which govern these procedures are reviewed in this paper. Data pertaining to the regulations were gathered from IMO conventions as they were enacted according to their timeline. Operational data were gathered from peer reviewed journal articles and websites, which analyse procedure of particular recycling location.

Results were tabulated as they occur in recycling locations and compared against the existing regulations. Ways to narrow down the existing gaps in the present operational procedures and regulations are detailed in the conclusions chapter.

E. Method

This study was conducted to analyse the factors influencing the sustainable shipbreaking operation and what future developments require to steer it towards sustainability. The methodology used in this study is more of qualitative nature supported by statistical data collected from Clarkson Research Services Limited, United Kingdom and Kable Intelligence Ltd, United Kingdom, which provide maritime market statistics through "Ship Technology.com". The operational aspect of shipbreaking industry was analysed from the data collected from peer reviewed articles and journals of Institute of Marine Engineering, Science and Technology library and also from various other web journals and articles referred at the references.
Shipbreaking operations at the following locations were analysed from the data collected.

- Alang Sosiya ship recycling yard, Gujarat, India. [23].
- Mabiya shipbreaking yard, Chittagong, Bangladesh. [24].
- Gadani shipbreaking yard, Karachi, Pakistan. [25].
- Changjiang shipbreaking yard, Jiangyin City, China. [27].
- Isiksan shipbreaking Yard and trading Co. Ltd, Izmir, Turkey. [26].

Data pertaining to the regulations were accessed from publications and websites of the International Maritime Organization, International Labour Organization, Secretariat of the Basel Convention.
Operational data collected from the above locations were analysed against their conformity with existing maritime and labour conventions and regulations, gaps were analyses and recommendations were proposed to fill in the gaps.

E. Results

In order to evaluate the influence of external factors in sustainable ship breaking industry, ship breaking operations in different locations and existing regulations that governs this operation were studied.
Existing regulations do not have provision to regulate ship breaking procedure available globally, neither do they dictate shipowners choice in picking up a particular yard.

Basel Convention (Annex 3 of appendices)
Date adopted - 22nd March 1989
Date ratified - 5th May 1992, Number of Signatories - 116 nations at present.
Summary of the convention - Control of Transboundary Movements of Hazardous Wastes and Their Disposal.

European Commission regulation.
Date adopted - 20th Nov 2013,
Date expected to be ratified - 31st Dec 2018.
Summary of the regulation - European ship owners and flag states' obligations in ship recycling, approved list of ship recycling facilities and waste shipment regulations.

Hong Kong Convention
Date adopted – 15th May 2009
Nations ratified the Convention at present are the Democratic Republic of Congo, France, Panama, Norway and Belgium.
The results gathered from Clarkson Research Services Limited [28]., Ship Technology.com [29]. and Brussels based NGO Platform on Shipbreaking the following results were tabulated.

TABLE I.
GLOBAL RECYCLING DESTINATIONS AGAINST TONNAGE RECYCLED IN 2015

DESTINATION	GROSS TONNAGE
Bangladesh	6,759,633
India	4,523,347
China	4,148,851
Pakistan	3,731,532
Turkey	1,083,104
Rest of the World	134,496

Source: PLATFORM annual report, 2015

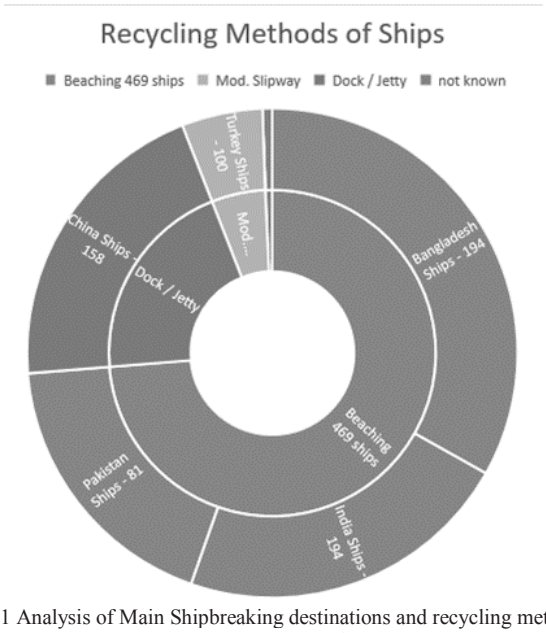

Fig. 1 Analysis of Main Shipbreaking destinations and recycling method. Source - PLATFORM annual report, 2015

Above results show during the year ending 2015, almost three quarters of recycled vessels (73%) were sold to south Asian beaching yards. Annex II of appendices provides a detailed result.
The following chart shows who sold those vessels to beaching yards.

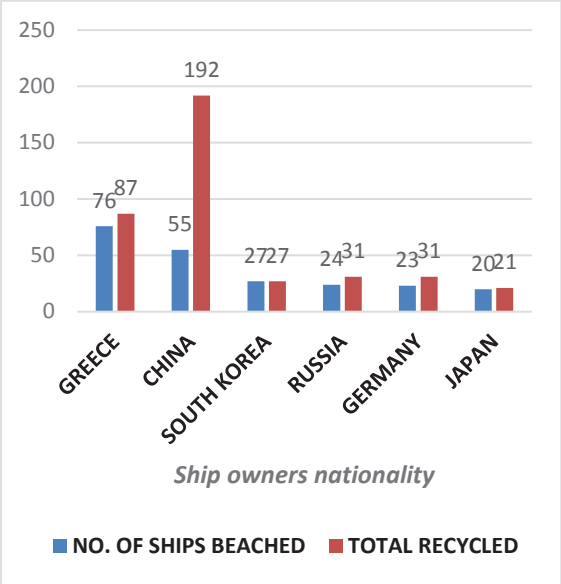

Fig. 2 Owners of recycled ships in 2015, Source - PLATFORM annual report, 2015

In spite of USD 200 / Tonne subside for Chinese ship owners, China sold 28.6% of their end of life tonnage to Asian beaching yards. (USD- United States Dollars)
Results show more ship owners prefer beaching to greener methods.

TABLE II.

YEAR	2012	2013	2014	2015	2016	2017
USD/TONNE STEEL	663.3	624.6	570	413	365	395

Global steel price, Source - Steel price forecast, 2017

TABLE III.

Destination	India	Ban'desh	Pakistan	China	Turkey
USD/LDT Tonne	380	370	370	205	245

Source - Ship technology.com

Above shows price in USD for a light displacement tonne (LDT) offered to ship-owner at the end 2015. (Ship technology.com)

Since scrap steel is used in steel manufacturing process price offered per light displacement tonne of steel to shipowners has a correlation with global steel price. China offers lowest for LDT due to their high overheads in building greener yards and overcapacity of yards [17].
Results obtained studying regulatory framework guiding ship breaking process are included in the appendices.

F. Discussion

Out of the factors influencing the sustainability of the ship recycling industry, existing regulations governing the operation and how operational procedure is being carried out in major ship breaking yards are analysed here.

Basel Convention refers the ship, a waste on its way to recycling yard, and convention controls or in some cases prohibits the transboundary movement of waste. A vessel which was sold for recycling away from recycle state, which still carries cargo, sails on its own power could hardly be called waste. Further, vessel's light displacement consists major portion of steel, that could be productively recycled, hardly would be wasted. Under the pretext of continued operational use most shipowners do not declare the intent to recycle their vessels, neither documents required by the Basel Convention and thus escape from law enforcement. This ambiguity of calling a ship waste on her final voyage needs to be rectified in future regulations in order to plug these loopholes.

Basel Convention fails to place any obligations to recycling yard or the state where the ship is recycled, but place heavy burdens on flag state and shipowners or owning state. This drives shipowner to change the flag state to a more lenient flag at the time of handing over for recycling, further there is no prohibition to change the flag state either in Basel Convention or in EU regulation.

EU regulations bring forward Hong Kong convention, which is yet to be ratified. The EU convention, which will come into effect from Dec 2018, has an approved list of recycling yards, but has not approved any intertidal zone beaching yards (Annex 1). EU shipowners will have to recycle their vessels in these approved yards. Since EU contributes to the major part of beached recycling, this will create a higher demand in scrap steel in Asia, prices will rise, recycling yards can offer further higher prices for LDT. The result will be the ship owners will somehow find a way to increase their profitability by selling their ships to beaching yards. However, EU regulation so far seems to be the only way out since it sets a global standard for sustainable ship recycling at least for European ship owners. With regards to operational procedure, results show yards in intertidal zone can offer a higher price for LDT due to their cheap labour and underdeveloped infrastructure. Cutting down a vessel on a beach does not allow for safe working conditions and the full containment of pollutants, leak into the water and soil. Most of hazardous material is not disposed of safely and are either illegally dumped or resold on the local markets since no documented procedure available in international or national regulations.

Most of the leading ship owning states taking advantage of this beaching model to improve their profits. This process does not improve the sustainability of recycling unless national regulations governing recycling procedure are geared to enforce yard owners to improve the quality.

Out of major ship recycling yards Turkey has a higher possibility of getting into the EU white list of ship breaking, further it is in a better position of offering a higher rate per LDT since it is a major steel producing country in Europe. (Annex 4 of Appendices). Underlying fact the above results indicate is, the majority of shipowners, whatever their nationality, would prefer beaching in the intertidal zone to greener recycling in order

to maximise their profitability which seem to be their main intention.

II. CONCLUSION

In order to achieve sustainability in beaching yards, where a ship is broken down directly on the sand, in the intertidal zone, regulations governing the operation has to be tight and fool proof. A ship arriving at the beaching yard should be completely free of hazardous material to make it a sustainable operation. All internal mountings should be so fitted that they can be dismantled at a transit station before she arrives at the beach. Tanks should be emptied, clean and gasfreed. This is a difficult task to achieve unless vessel's recycling has been planned at the building stage. Recycling survey has to be mandatory and it should be a part of the renewal survey where the inventory of hazardous material and readiness for recycling is demonstrated and confirmed.

The regulations should have a mechanism to provide level playing fields to all global recycling yards.

As it is shown in the results of this report China has marked improvement in reducing in beaching, they have achieved it by offering additional 200 USD for a LDT to Chinese shipowners. This model can be used in EU, Japan and South Korea since they are bigger ship owning nations, and all of them they have sustainable ship recycling yards. Maximising the profit of the shipowners is the main driver of the industry. Beaching yards offer a higher price since their overheads are low due to poor infrastructure and unskilled lowly paid workforce. As shown in the results, Chinese yards pay 205 USD per LDT while all beaching yards pay around 375 USD per LDT. With an incentive of 200 USD/LDT, China has managed to divert shipowners to more sustainable yards. This appears to be the only way to get beaching yards to improve their recycling methods. Since the local regulations in beaching locations are geared to maximise national profits, and ship recycling plays a major role in their income generation and employment, transformational changes in beach recycling cannot be expected in the near future. Hong Kong convention even if it comes into force will not have any effect in reflagging the vessel prior to its last voyage, neither does it controls the downstream waste management at the recycling yard. Ship dismantling is an industrial activity that needs industrial methods, equipment and standards. Recycling is a global necessity to phase out end of the life vessels in a sustainable manner, so it requires global attention and funding. A beach is not an appropriate place for a high-risk heavy industry involving hazardous waste management. Beach locations and intertidal zone operations cannot close all the gaps to ensure safe recycling operations and full containment of pollutants.

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Appendices. Annex 1

Country	Name of the facility	Method of recycling
Belgium	NV Galloo recycling ghent	Alongside (wet berth), slope
Denmark	Fornaes ApS	Dismantling by quay
	Smedegaarden A/S	Dismantling by quay
France	GARDET & DE BEZENAC Recycling/Groupe BAUDELET ENVIRONNEMENT GIE MUG	Floating & slipway
France	Grand Port Maritime de Bordeaux	Alongside, drydock
France	Les Recycleurs bretons	Alongside, drydock
Latvia	A/S,, Tosmares kugubuvetava	Ship dismantling (wet berth and dry dock)
Lithuania	UAB APK	Alongside (wet berth)
Lithuania	UAB Armar	Alongside (wet berth)
Lithuania	UAB Vakaru Refonda	Alongside (wet berth)
The Netherlands	Keppel Verolme	Shipbreaking
The Netherlands	Scheepsrecycling Nederland B.V.	Shipbreaking
Poland	Almex Sp. Z o.o.	Piers and recycling plots on land-sea interface
Portugal	Navalria – Docas, Construcoes e Reparacoes Navais	Dry dock dismantling
Spain	DDR VESSELS XXI, S.L.	Dismantling ramp
United Kingdom	Able UK limited	Ship dismantling and associated treatment authorizes with dry dock and wet berth

European list of recycling facilities.

Annex 2

DESTINATION	NO OF SHIPS RECYCLED	RECYCLING METHOD	GROSS TONNAGE
Bangladesh	194	Beaching	6,759,633
India	194	Beaching	4,523,347
China	158	Dock / Jetty	4,148,851
Pakistan	81	Beaching	3,731,532
Turkey	100	Mod. Slipway	1,083,104
Rest of the World	41	not known	134,496

Analysis of ship recycling at major global destinations.

Source - PLATFORM annual report, 2015

OWNER	NO. OF SHIPS BEACHED	SLIPWAY / DOCK	% Beached
GREECE	76	11	87.4
CHINA	55	137	28.6
SOUTH KOREA	27	0	100
RUSSIA	24	7	77.4
GERMANY	23	8	74.2
JAPAN	20	1	95.2

Annex 3

Parties to the Basel Convention

Annex 4

Top 20 Steel producing countries