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## Ship recycling in developing economies of South Asia: Changing liability to a commodity

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## Ship Recycling in developing economies of South Asia: Changing liability to a commodity

**Abstract.** The end-of-life (EOL) of ships which is neglected and considered a liability by developed economies of the western world. However, it has become a commodity in the developing economies of South Asian countries. Ship recycling activities are considered extremely dangerous by the International Labour Organization (ILO); however, if ship recycling operations are well-managed then they can play a vital role in achieving circular economy and UN sustainable development goals. Thus, there is an immediate need to identify the opportunities and challenges faced by ship recycling industries. Hence, this study compares recent developments in the leading ship recycling countries. Subsequently, it illustrates the socio-economic benefits and assesses the current scenarios of ship recycling. In addition, SWOT analysis was performed to identify the strengths and opportunities present in South Asian countries as well as the weaknesses and threats that should be considered while performing ship recycling operations.

**Keywords:** Ship recycling; SWOT analysis; end-of-life; EOL; circular economy; UN sustainable development goals; South Asia

### 1. Introduction

All ships eventually reach a point where maintaining them is neither feasible nor cost-effective. Most ships are dismantled or repurposed when their useful lives, which last 20 to 30 years on average, are over. Ship recycling is becoming an element of the sector's regulatory framework as the maritime industry works toward decarbonization where aged ships become redundant (Chang, Wang, & Durak, 2010). Ships are sizeable engineering products that are difficult to "throw away." Initially, ships that have reached the end-of-life (EOL) after serving in the oceans, have been either abandoned, sunk, or broken up to dispose of in small chunks to be recycled. Shipbreaking, the first step of the recycling process, as opposed to sinking or abandoning aged ships, seems to be the most eco-friendly and financially sensible choice because it enables better handling of hazardous substances and the utilization of valuable resources like iron, steel, aluminium, and polymers. However, a very small proportion of shipbreaking activities are conducted safely and efficiently (Mathew, 2021; Mikelis, 2018).

Shipbreaking is regarded as a dangerous but demanding task that poses significant risks to both humans and the environment. For example, labours are usually required to work at heights or in cramped areas with little to no personal protective equipment (PPE), and ship structures are often contaminated with toxic substances like asbestos, oil residues, PCBs, organic wastes, heavy metals, and toxic paints. Even knowing the dangerous working circumstances and lax implementation of labour laws; the ship owners of the Western world choose to export their ships to South Asia for scrapping since the region offers a better value of scrap than other ship recycling yards throughout the world (Rahman, Handler, & Mayer, 2016; Sujauddin et al., 2015). The value the shipbreaker is ready to offer to the ship owner for selling an EOL ship is dependent on the lightweight tonnage of steel that could be recovered through shipbreaking. Based on market conditions, such as shipping rates and depreciation in domestic currencies, the value varies from place to place and is prone to change over time. The price gap represents cost variations relating to safety and environmental management, in addition to the price differential resulting from the various local markets for steel products. Beaching shipyards can bid higher for the ships because they externalized these costs to the local society, environment, and workforce (K. P. Jain & Prueyn, 2017).

For as long as there has been industrialization and development, achieving a sustainable environment, economic progress, and human rights; has proven to be a challenge for authorities in developing nations. One sector that has recently been under immense pressure from both national and international stakeholders to conduct its operations sustainably is the ship recycling industry in developing nations (Demaria, 2010). The ship recycling industry in Bangladesh employs about 40,000 people in management, administrative, and technical positions. About 60% of Bangladesh's total steel demand is met via ship recycling. The industry in Alang (India) directly employs over 30,000 people, and it generates yearly revenue of about sixty billion Indian rupees i.e., more than 756 million dollars. Around 12000 people are employed by the ship recycling yards in Gadani (Pakistan) and the sector provides around 15% of the nation's steel needs (Costa & Sahu, 2020).

## **2. Recent developments in the leading ship recycling countries**

### *2.1. India*

In 2021, the Indian Finance Minister stated that the capacity of ship recycling would be quadrupled by 2024 and this ambition has led to import more ships from Japan and Europe. According to the finance minister, this will result in the creation of 150 thousand jobs. It was anticipated that if the Recycle Act is passed, India can expect to have 50% of the world's share in shipbreaking since many nations would prefer to send their ships to India. Previously, developed nations like Europe, Japan, and the United States were hesitant to send ships to India for ship recycling in the absence of the adoption of a worldwide agreement. That situation is now changed with the Recycling of Ships Act, 2019. The Act endorses the Hong Kong Convention (HKC) and facilitates an eco-friendly ship recycling process and sufficient welfare of the yard laborer. The Ministry of Ports, Shipping, and Waterways have asked for a 50% increase in financial allocation to improve ship recycling capacity at the Alang Ship Breaking Yard. Once additional ships begin to arrive in India for recycling, the sector of ship recycling contributing towards GDP would increase to 2.2 billion dollars from the current contribution of 1.3 billion dollars as per the Economic Times (ET, 2021).

### *2.2. Bangladesh*

In Bangladesh, ship recycling plays a significant role in the development of the country's economic growth, industries, and infrastructure but as Rahman et al (2016) pointed out, it comes at the expense of the health of workers and the environment. Ship scraps have replaced iron ore as the primary source of raw materials for Bangladesh's steel and iron industries because the country lacks an iron ore deposit. The primary hub of Bangladesh's shipbreaking business is situated in Sitakunda, on the Bay of Bengal, to the north of Chittagong. According to Das and Ali (2019), ship recycling operations provide over 60% of the raw materials for about 350 local steel manufacturers. Now, IMO has taken the initiative with Norway investing around 1.5 million dollars to assist in enhanced ship recycling and implemented the third phase of the SENSREC (Safe and Environmentally Sound Ship Recycling) project in Bangladesh. This would open the way for Bangladesh to become a party to the IMO and HKC, the convention that will establish worldwide standards for safe and ecologically sound ship recycling (IMO, 2020).

### *2.3. Pakistan*

Gadani, located 50 kilometers west of Karachi, is where its ship recycling yards are situated. The Balochistan Development Authority (BDA) owns parts of the yards, but the bulk is rented from private property owners. Shipbreaking and recycling businesses contributed significantly to Pakistan's economy in the 1980s by providing a substantial amount of re-rollable scrap steel to the steel and iron sectors. Additionally, Pakistan's ship recycling industry has been paying the federal and provincial governments between 5 and 12 billion Pakistani rupees in taxes annually (Hameed, 2019). Consequently, conflicting economic policies in the past 20 years, hurried adjustments to the tariff and other charges on the import of ships for scrap; and, most importantly, overall disregard for the ship recycling industry, has negatively impacted work at Gadani. According to the NGO shipbreaking platform (NGO, 2017) the sector employs between 5000 and 20,000 people, the majority of whom are migrant workers from the most underdeveloped regions within Pakistan. According to Hameed (2019), over 70% of the scrap steel is supplied to rerolling mills in Karachi, and approximately 95% of the industry's income comes from the selling of ship scrap steel.

### *2.4. China*

China, the world's fourth-biggest shipbreaking country, has barred all foreign ships from entering China for recycling enacted by the Chinese government from 2018 onwards (Sunaryo, Djatmiko, Fariya, Kurt, & Gunbeyaz, 2021). The Chinese government has announced a modification to the legislation in April 2018 for several prohibited items, to curb the environmental pollution in the country, as China was formerly the world's largest importer of waste materials (Nan, 2018). China's scrapyards, which are among the most eco-friendly in the world, are now forced to rely on local tonnage for revenue. According to Xie Dehua, the director of the China National Ship Recycling Association (CNSA), the restriction would have a significant impact on shipbreaking yards in China thus will face challenges years ahead and many will need to diversify their operations.

### **3. Socio-economic benefits of ship recycling in South Asian countries**

#### *3.1. Metal Retrieval*

Metal scrap collected from decommissioned ships comprises both ferrous and non-ferrous scrap. There are two types of scrap: melting scrap and re-rollable scrap. Almost 60% of the ship's steel is gathered in the form of re-rollable scrap in South Asian ship recycling yards which includes plates, girders, beams, and angle bars. The re-rollable steel is worth way more than the remaining melting scrap, which is made up of uneven fragments of steel labelled as melting steel. Re-rollable commodities are extensively utilized in these countries' construction sectors, whereas melting steel pieces are used to produce steel commodities at a foundry (K. P. Jain & Pruyn, 2017). In South Asia, the shipbreaking sector's reclamation of re-rollable and melted steel scrap, and subsequent sale to steel factories, is critical since this route accounts for nearly half of steel supply. Similarly, in terms of providing scrap to the iron and steel sector, the ship recycling business is essential for South Asian countries. Shipbreaking provides a substantial resource of steel to the country and, as a result, saves a considerable amount of foreign exchange by lessening the demand to import steel. Currently, Bangladesh has remarkably high demands for steel, but the country does not have iron metal sources or mines which makes ship recycling a necessity and the biggest source of steel.

#### *3.2. Build-up local economy*

The industry of ship recycling in South Asia generates a substantial flea market for used products such as furniture, machines, woodwork, electronic devices, home appliances, home furnishings, oils, and engineered products. Since the aforementioned used products that are subsequently sold in the flea market are considered as the input to small-scale businesses, this gives credibility to the concept of the circular economy (K. P. Jain & Pruyn, 2017). Re-rolling mills and steel furnaces utilize ships' ferrous scrap to manufacture steel commodities like ingots, alloys, tubes, and sheets. The whole market of steel and used products resulting from ship recycling gives a substantial boost to the local economy and creates thousands of jobs. More than 60% of SMEs in South Asia are using scrapped steel from ship recycling as a raw material. A lot of small and medium enterprises including light and heavy engineering industries are relying upon the re-rollable steel of the ship recycling industries (K. Jain, 2018).

#### *3.3. Generate government revenue*

Shipbreaking creates a lot of income for the Government as well through the tax payments. Consistently, the Government gathers revenue from the shipbreaking industry through different types of taxes like import duties, yards taxes, and other related taxes (Hameed, 2019; Mathew, 2021). Ship recycling contributes around 1.3 billion dollars to Indian GDP according to the economic times (ET, 2021) and nearly 2 billion dollars to Bangladesh's GDP according to the financial express (FE, 2022)

#### *3.4. Job creation*

The ship recycling yards and associated businesses such as re-rolling mills, refurbishing shops, second-hand markets, and steel plants generate localized employment that directly or indirectly supports thousands of people from the most vulnerable sections of society. Shipbreaking generates employment and sources of income. Regardless of the situations that the labourers are working under, this is a business that employs thousands of individuals directly while millions of individuals are involved implicitly. It offers employment and income for the neediest individuals who, otherwise, would have no earnings (Rizvi, Islam, Adekola, & Margaret, 2020; Sujauddin et al., 2015).

#### *3.5. Reduced emission and Pollution*

Using scrap metal instead of metal ore to produce finished products is seen as an advantage to reduce greenhouse gas emissions (GHG). The reduction in emissions is due to a reduction in energy usage in steel manufacturing of up to 70% when scrap steel is utilized instead of iron ore. Furthermore, the demand for steel extraction is minimized, which leads to a decline in GHG emissions (Khandakar Akhter Hossain, 2017). Shipbreaking should, therefore, be considered as a "green industry." Not only a ship itself, almost everything aboard an EOL ship is reused, repurposed, or resold through recycling. A ship's scrap may be used as raw materials for steel plate re-manufacturing, steelworks, asbestos re-manufacturing, and supplying furnishings, electrical cable and components, and oils to different SMEs (K. Jain, 2018; Mathew, 2021). The points that are mentioned above about the ship recycling business attest to the fact that the sector is great for the environment and society. However, authorities and organisations around the world have expressed their concerns regarding the method by which ships are demolished in some of the yards in the South Asian subcontinent. This is because the way ships are demolished

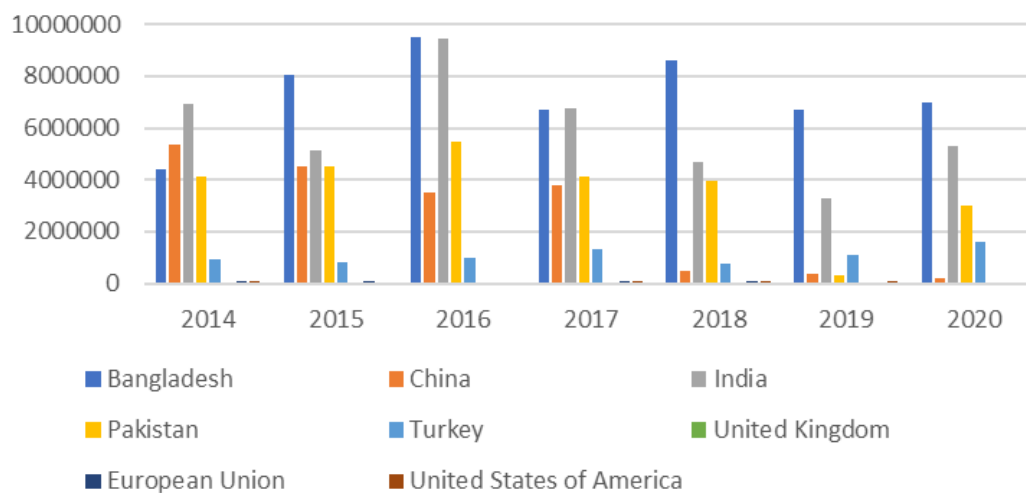
may undoubtedly have an impact on the ecosystem, as well as on the health and safety of the workers. As a result, the necessity to upgrade the substandard facilities cannot be denied.

### 3.6. Reduce the reliance on the steel industry

Ship recycling provides a significant amount of scrap material to the iron and steel sectors reducing the need to create virgin metals to satisfy demands. According to a report issued by the World Bank (TWB, 2010), national ship recycling fulfils 50% of Bangladesh's steel needs. Pakistan had a figure of roughly 15% while India had a figure of 5-6%. According to McKinsey & Company (McK&Co, 2020), a tonne of steel produced from ore generates nearly 1.85 tonnes of CO<sub>2</sub> which globally accounts for nearly 8% of CO<sub>2</sub> emissions. Consequently, steel companies around the globe, notably in Europe, are increasingly faced with the issue of decarbonization. So, to address the decarbonization issues and challenges, ship recycling is a good alternative as it will meet some percentage of global steel demand (K. Jain, 2018).

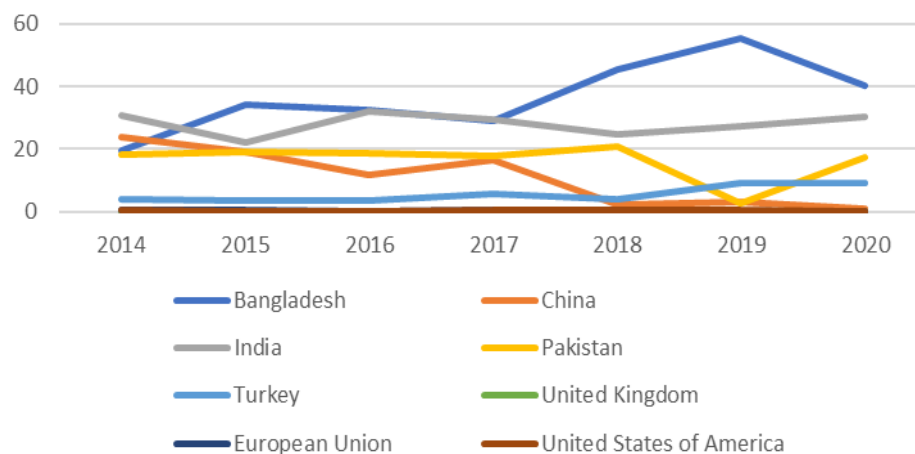
## 4. Current scenarios related to shipbreaking /ship recycling in South Asia compared to the rest of the world

In this section, various graphs are plotted that are related to ship recycling and shipbuilding by different countries with the average life and size of the ship using the database of the United Nations Conference on Trade and Development (UNCTADstat, 2022). UNCTADstat database is used because of its accuracy and reliability as it compiles, process, and validate a vast range of data for almost all the countries in the world through different sources.



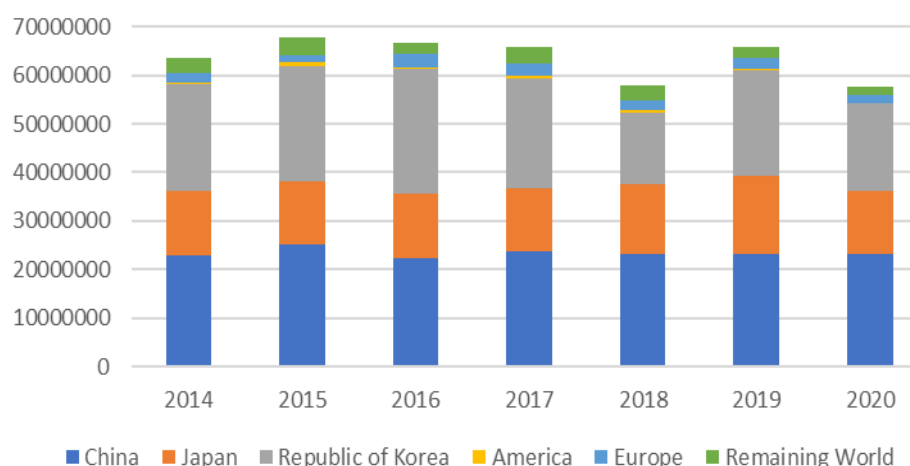
**Figure 1:** Ship recycling by different economies in gross tonnage (GT).

Figure 1 shows various economies that have performed shipbreaking around the world from 2014 to 2020. Overall, developing economies like Bangladesh, India and Pakistan are more involved in ship recycling compared to developed economies like the UK, the US, and the EU. The Figure reveals that China is reducing ship recycling activities over the years and this trend is possibly due to China's recent implementation of tighter ship recycling policies. Notably, Turkey is now more involved in shipbreaking activities resulting an increase in ship recycling gross tonnage in recent years.



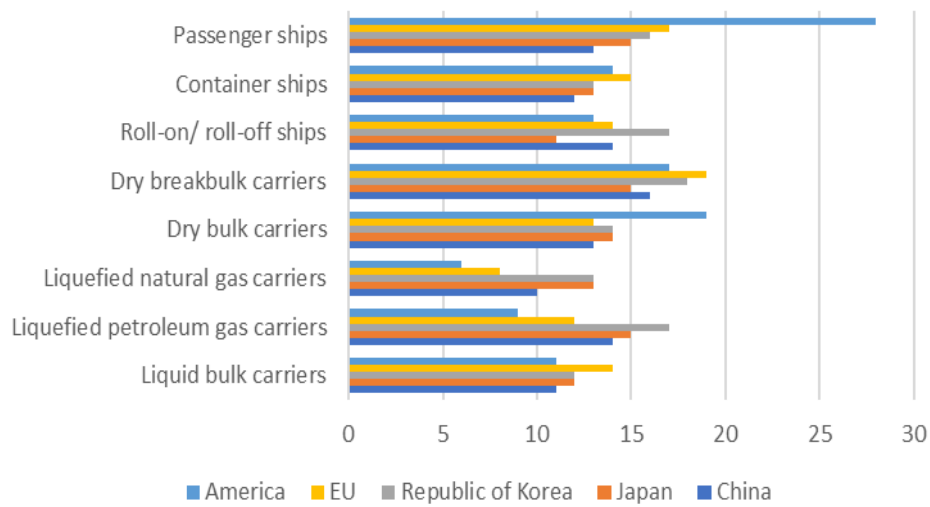
**Figure 2:** Ship recycling done by different economies around the world in percentage of total tonnage recycled.

Figure 2 shows the shipbreaking activities in South Asian countries like Bangladesh, India, Pakistan compared to China, Turkey, the US, the UK, and the EU. In recent years, Bangladesh contributes to shipbreaking activities by 40% to 55% and India by nearly 30%. Also, on average, Pakistan contributes almost 20% to shipbreaking activities. Earlier, China contributed more than 20% of shipbreaking activities which is then reduced to nearly 1%. Although initially, Turkey contributed 4.14% of shipbreaking activities, their contribution has increased to 9.19% in recent years. On the contrary, the US, the UK, and the EU practically contribute nothing to shipbreaking activities.



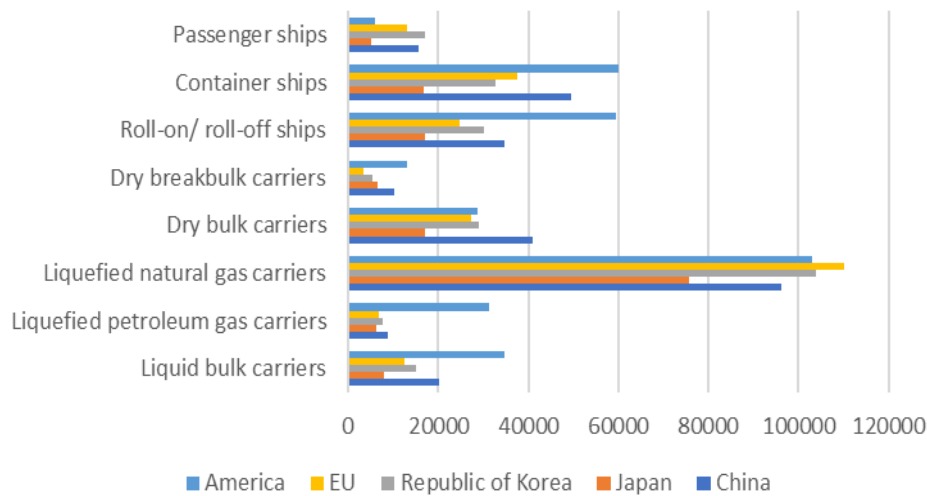
**Figure 3:** Ships built by different economies annually in gross tonnage (GT).

Figure 3 shows the gross tonnage of ships built by China, Japan, the Republic of Korea, America, Europe, and the remaining world. Most of the ships are built by only three nations i.e., China, Japan, and the Republic of Korea while the western world has modest contribution to shipbuilding in all time. Nearly, 60 million GT were contributed to shipbuilding by only these three nations whereas only 5 million GT were contributed by America, Europe, and the rest of the world. It is interesting to note that the EOL ships brought to the South Asian shipbreaking yards are mainly from the developed nations although they do not build enough ships by themselves.



**Figure 4:** The average age of different types of ships (in years).

Figure 4 shows the average age of different types of ships used in China, Japan, the Republic of Korea, America, and the European Union. Overall, the average age of liquefied natural gas carriers is the least and on the other hand, dry breakbulk carriers and passenger ships have the most average age in years. The average age can be as low as 6-8 years for liquefied natural gas carriers and can be as high as 28 years for passenger ships in America.



**Figure 5:** The average size of ships in gross tonnage (GT).

Figure 5 shows the average size of ships in gross tonnage used in China, Japan, the Republic of Korea, the United States of America, and the European Union. Overall, the average size of liquefied natural gas carriers has the most in GT, and on the other hand, dry breakbulk carriers have the least average size in GT.

Considering Figures 1,3 and 4, it can be concluded that the ship recycling capacity at present is less than one-third of the total shipbuilding capacity. In the next 15 to 20 years, most of the ships that are built in recent years will need to be discarded but the situation would be exceptionally critical in the absence of sufficient numbers of environmentally friendly shipbreaking yards. So, the whole world (if not, at least the South Asian countries) will need to increase ship recycling facilities that are economically, socially, and environmentally viable to cater to the safer decommissioning of ships. Also, when considering figure 5 i.e. the average size of the ships and the green ship recycling facilities present in the EU countries, all of the EU ship recycling facilities are small in size and cannot handle the ship above 30000 GT and ship recycling in these facilities is expansive (Sornn-Friese et al., 2021). It creates opportunities for South-Asian countries that can handle large ships at a low cost.

## 5. SWOT Analysis

Strengths (S), Weaknesses (W), Opportunities (O), and Threats (T) make up the acronym SWOT. It is an analytical technique based on organizations' strategic planning, examining internal (S and W) and external (O and T) factors to build appropriate and cogent plans to strengthen or improve the market position of the engaged firm. Contrary to external factors, which cannot be controlled, internal factors are within the control of an organization (Weihrich, 1982). To leverage the strengths to maximize chances while balancing out the weaknesses and addressing threats, it is helpful to choose these factors, combine them, and put them into a matrix using SWOT analysis. The matrix enables these aspects to be brought together in a way that will result in the formulation of long-term strategies and goals (Bakhtari, Waris, Mannan, Sanin, & Szczerbicki, 2020).

The method was originally created by Weihrich in 1982, and it was first applied for strategic considerations and decision-making in the marketing and management domains of businesses. Many administrators have admitted to adopting the SWOT technique in various international surveys to assess their global market potential and discover potential future trends and plans (Meza, Koç, & Al-Sada, 2022; Weihrich, 1982). The method, however, is not just applicable to management; it can also be used to create national policies and improve their energy and resource bases. For instance, it was used to examine China's shale gas development in natural gas (Azubuike, Songi, Irowarisima, & Chinda, 2018). Additionally, Azubuike et al (2018) has used it to address legal and regulatory concerns with Algeria's potential shale gas development.

In this study, the SWOT factors are compiled and categorized as internal factors and external factors in the SWOT matrix (Figure 6) after assessing the enablers and the barriers in ship recycling identified by various studies such as: (Abdullah, Mahboob, Banu, & Seker, 2013; Choi, Kelley, Murphy, & Thangamani, 2016; Demaria, 2010; Frey, 2015; Kh Akhter Hossain, Ali, & Zakaria, 2012; Hougee, 2013; K. Jain, 2018; K. P. Jain & Pruyn, 2017; Mathew, 2021; Rahman & Kim, 2020; Sujauddin et al., 2015). South Asian countries have so many strengths in terms of ship recycling which can create a lot of opportunities. However, there are some weaknesses that can create a threat to the ship recycling industry in South Asia.

	INTERNAL FACTORS	EXTERNAL FACTORS
	STRENGTHS(S)	OPPORTUNITIES (O)
ENABLERS	<ul style="list-style-type: none"> <li>• Low-cost labour availability</li> <li>• South-Asian developing economies like India, Bangladesh, and Pakistan have the geographical advantage of high tidal level</li> <li>• Environmental Policies and taxation</li> <li>• Availability of substantial yards</li> <li>• Government support</li> <li>• Handle large ships</li> </ul>	<ul style="list-style-type: none"> <li>• Direct demand for Ferrous &amp; non-ferrous material by SMEs</li> <li>• In-direct market opportunity</li> <li>• Decarbonization through sustainable ship recycling</li> <li>• Reduce virgin material liability</li> <li>• Ship recycling yard Certification</li> <li>• Boost the local and national economy</li> <li>• Enhance socio-economic wealth</li> </ul>
BARRIERS	WEAKNESSES (W)	THREATS(T)
	<ul style="list-style-type: none"> <li>• Inadequate Infrastructure</li> <li>• Lack of Training for skill development</li> <li>• Inadequate standards and guidelines</li> <li>• Unavailability of proper disposable sites for hazardous material</li> <li>• Funding for capacity building</li> </ul>	<ul style="list-style-type: none"> <li>• Fluctuation in Foreign Exchange Market</li> <li>• Lack of Ship availability due to Non-compliance</li> <li>• Expansion of green ship recycling by developed countries</li> <li>• Legal issues due to lack of Safety and health insurance facilities</li> <li>• Higher bid value by developed countries</li> </ul>

**Figure 6:** SWOT matrix for South Asian ship recycling.

Ship Recycling in developing economies of South Asia has become a commodity as there are numerous enablers or strengths of South Asian ship recycling yards as compared to any other ship recycling yard present in other parts of the world as shown in figure 6. The main enabler or strength is the low-cost labour availability and the



capacity to hire large numbers of labours with low wages (Choi, Kelley, Murphy, & Thangamani, 2016). Most of the South Asian yards are substantial in size that can handle large ships which cannot be recycled in the European shipyards (TWB, 2010), and now, the government started to support ship recycling activities in South Asian countries like India and Bangladesh as it creates revenue (ET, 2021; FE, 2022). Ship recycling activities create a lot of opportunities for South Asian countries in a form of jobs for the most vulnerable ones. It also significantly increases their own country's revenues by creating direct and indirect market opportunities and meeting a substantial portion of Bangladesh, India, and Pakistan's steel needs which reduces virgin material liability and ultimately boost socio-economic wealth (K. Jain, 2018; Rahman et al., 2016; Sarraf, 2010; Sujauddin et al., 2015; Sunaryo et al., 2021).

Although, there are many strengths and opportunities exhibited by South Asian ship recycling yards; However, there are some barriers that are created due to weaknesses and threats faced by the South Asian ship recycling industry. The weaknesses are inadequate infrastructure for sustainable ship recycling, lack of Training for skill development for safer shipbreaking, inadequate standards, and guidelines developed for proper disposal, and unavailability of proper disposable sites for hazardous material which is due to the lack of funding for capacity building (Demaria, 2010; Moen, 2008; USEPA, 2000). The threats are fluctuation in the Foreign Exchange Market, lack of Ship availability due to Non-compliance with regulations, expansion of green ship recycling by developed countries or higher bid value by developed countries, and legal issues due to lack of Safety and health insurance facilities (Alam & Faruque, 2014; Frey, 2015; Kh Akhter Hossain et al., 2012; K. P. Jain & Pruyn, 2017).

## **6. Discussion and conclusions**

In recent years, the world has seen a continuous growing outrage about maritime safety, and in response to those outrages, regulatory authorities are becoming more engaged in the design for safer operation and maintenance of ships. However, the end-of-life (EOL) of these ships is often neglected during the design phase and considered a liability by the developed economies of the western world. However, it becomes a commodity for the developing economies of South Asian countries like India, Bangladesh, and Pakistan in the last decade as it creates socio-economic wealth for South Asian countries through metal retrieval, building up the local economy, generating revenue for the government, job creation, reduced emission and pollution and reduce the reliance on the steel industry. Shipbreaking activities play a vital role in achieving the circular economy and sustaining the economies of these South Asian developing countries and provide employment opportunities on large scale to both skilled and unskilled labour and yet consider one of the most unsafe occupations by the International Labour Organization (ILO) which poses severe threats to human health and environment.

Thus, there is an immediate need to identify enablers and barriers that are faced by the ship recycling industry of South Asia. Hence, this study compares the recent development plans for ship recycling in the leading shipbreaking countries and illustrates the socio-economic benefits of ship recycling and assesses the current statistics on ship recycling using the data of the United Nations Conference on Trade and Development (UNCTAD). The assessment shows that the South Asian countries are the leading ship recycling countries, and the current capacity of ship recycling is one-third of the shipbuilding capacity. Thus, there is a critical need to expand the capacity of ship recycling in south Asian countries that are safer and environmentally friendly. Also, the average size of most of the ships as compared to EU ship recycling facilities is more which creates opportunities for South-Asian countries like India, Bangladesh, and Pakistan as they can handle different sizes and types of ships and generate profit for both ship owner and ship recyclers. At last, a SWOT analysis that identifies the strengths and opportunities as the enablers and shows the tremendous potential of South Asian countries in the ship recycling industry and presents the weakness and threats as barriers that should be considered while performing ship recycling operations.

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