Kojima and Michida ed., *Economic Integration and Recycling in Asia: An Interim Report*, Chosakenkyu Hokokusho, Institute of Developing Economies, 2011

# Chapter 7

# From Shipbreaking to Ship Recycling: the Relocation of Recycling Sites and the Expanding International Approach

Tadayoshi TERAO[1]

**Abstract**

In this chapter, we start with a brief history of the shipbreaking business from the middle of the 1960. And then, we discuss the main reasons why the industry shifted between countries, and describe the problems that arose from about 1990 onward, such as industrial accidents and environmental pollution. Also, we explain outline of "the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships" (the Ship Recycling Convention) concluded by IMO as an international measure to combat those problems, briefly, and show why it is important to build a sound ship recycling system through institutional arrangements.

***Keywords:*** Shipbreaking, Ship recycling, Scrap iron, the Hong Kong Convention

## Introduction

A large ship contains large quantities of useful metals, especially iron (in the form of steel). Several decades after launch, its life ends and it is scrapped, releasing many tons of recyclable metal. With so much metal and such a long life, its recycling is more like that of a building than of something of short lifespan and smaller size like, say, home electronics.

From the Bronze Age onwards, metal has been recycled as much as possible. Iron is comparatively easy to obtain from ore, but the process requires a blast furnace. It is much easier to recover it from scrap iron, which has thus become a very important raw material for iron manufacturing processes. Only few low-income economy, developing countries, even today, have blast furnaces, so that all their domestic iron production depends on recycled scrap iron. And most of developing countries do not

[1] Senior Research Fellow, Environmental and natural resource studies group, inter-disciplinary studies center, Institute of Developing Economies

have sufficient sources of scrap iron, as a form of old building and infrastructure constructed during the process of past economic development.

In most developing countries achieving rapid economic growth, demand is increasing for iron and steel products, for use in public infrastructure and private construction. Foreign currency restrictions make it difficult for developing countries to import all the iron and steel scrap they need, and in many cases the domestic steel manufacturing industry is underdeveloped too. The shipbreaking industry produces large quantities of iron. More homogeneous in quality than ordinary scrap iron, and mostly in the form of plates, it is ready for immediate re-use, at minimum reprocessing cost, as construction material.

The world's shipbreaking business has shifted from East Asian countries such as Japan, Taiwan, and South Korea, to South Asian countries such as India, Bangladesh, and Pakistan, as each country follows the curve of economic development. Recycled steel from shipbreaking continues to play an important part in the economic development of the countries where it is practiced.

The shipbreaking industry carries risks, however. After the shift of activity to South Asia from about 1990, problems of industrial accidents and environmental pollution increased alarmingly, and calls arose for international management and regulation. International organizations have taken measures. For example, UNEP (the United Nations Environment Program) produced the "Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal" (Basel Convention), and the International Maritime Organization (IMO) acted as a forum for shipping-related international argument, while the International Labor Organization (ILO) showed the serious concern for labor safety.

This chapter starts with a brief history of the shipbreaking business from the middle of the 1960. Section 2 discusses the main reasons why the industry shifted between countries, and Sections 3 and 4 describes the problems that arose from about 1990 onward, such as industrial accidents and environmental pollution. Sections 5 and 6 outline "the Hong Kong Convention for the Safe and Environmentally Sound Recycling of Ships" (the Ship Recycling Convention) concluded by IMO as an international measure to combat those problems, and shows why it is important to build a sound ship recycling system through institutional arrangements.

## 7.1 History of Large-scale Shipbreaking and Iron Recycling: From East Asia to South Asia

This section briefly reviews the world history of the shipbreaking industry over the last fifty years. Information is sketchy until the 1970s, the earliest time for which statistics could be obtained on international trends in the shipbreaking industry, especially for the locations at which the actual dismantling was carried out. Before that time, the only records available were very general, often no more than the flag states of the dismantled vessels In this section, by examining the original data of *Lloyd's Register*, as used by the most of earlier literature, we were able to extract data on the country of demolition from 1967. The international movement of world shipbreaking 1967 to 2008 is shown in Figure 1; only vessels of 100 gross tons (GT) or larger are counted as “ships” for this purpose.[1]

Analysis of the Lloyd's Register data for the period preceding the mid-1970s made it clear that Taiwan had overtaken Japan in the mid-1960s to become the world's largest shipbreaking country, remaining so until the end of the 1980s. Japan, Taiwan, and South Korea were joined in the 1980s by mainland China, so that, until the end of the decade, East Asia was the world center of shipbreaking.

Until the middle of the 1970s, only 50,000 GT (or less) per year were being dismantled. At that time, shipbreaking volumes increased, with an acceleration during the early 1980s to between 150,000 and 200,000 GT. From 1987 to 1990, however, there was a lull, and although rapid increase re-started in 1992, it is still below the 200,000 GT per year of the mid-1980s. There was another lull between 2004 and 2008, when a new upward trend appeared.

Country-by-country analysis allows us to investigate the geographical movement of the shipbreaking industry. In 1967, Taiwan dismantled 739,000 GT, Japan 796,000 GT, so Japan was the most active. In 1968, however, Taiwan’s share increased rapidly to 1,133,000 GT, becoming the most active in the world, while Japan declined to 388,000 GT. Taiwan remained at the top until 1988.

We have not analyzed data from before 1966, so there is currently no confirmation, but it is probable that Japan held the title of world’s busiest shipbreaker. The United States of America was also involved, however, at a scale approaching that of Japan and Taiwan, until 1972, as was Hong Kong.

Taiwan, South Korea, and China had insufficient capacity to cope with the rapid world demand for shipbreaking that started in 1982. Japan temporarily revived activities, with shipbuilders trying to regain entry to the market, assisted by government subsidy, as a

measure against the depression of shipbuilding industry in the 1970s.[2]

World shipbreaking suddenly contracted in the latter half of the 1980s, and when it started to recover in 1992, the major demolition countries had changed, with China the only remaining East Asia player. South Asian countries, such as India, Bangladesh, and Pakistan, took the lead as dismantlers of most of the world's large vessels. The track record fluctuates a little, as China took the lead in 1993, just before the South Asian countries suddenly increased their demolition, and kept level with them from 1999 to 2003.

As Japan had shown in the mid-60s, and Taiwan in the 1980s, secure acquisition of a dismantling yard in a proper port was an essential condition for shipbreaking business development. In South Asia from the 1990s, however, that condition changed drastically. In East Asia, countries like Japan, Taiwan, and South Korea, and many others, established a wharf in port, where initial rough disassembly was carried out using heavy equipment like large cranes, before decomposition into small iron plates and scraps by a labor-intensive process. In South Asia, the most used process is entirely different; it is called *beaching*. They run the vessel aground at high speed and at high water, using a beach with no port facilities at all, then cut it into slices and pull it apart by human power alone, the only concession to the twenty-first century being a winch whose wire can drag dismantled parts above the high-water line.

The South Asian practice is thought to have started when a large ship ran on the rocks and provided rich pickings for the local scrap iron recovering business, and to have developed into deliberate stranding on sand by the late 1980s. Shipbreaking is limited to specific areas, being concentrated in a suburb of Chittagong, a major harbor city of the eastern part of Bangladesh, and in the Alan area of Gujarat State on the West Coast in India. Although both areas have a long beach, suitable for shipbreaking by beaching, many other areas boast the same advantages, so natural conditions cannot fully explain this limitation of area—there is more discussion on this in the next section. Within South Asia, Bangladesh and Pakistan tend to disassemble bigger ships than India does; this trait has been constant ever since the early 1990s, when shipbreaking started to be carried out extensively in South Asian countries.[3]

For any given maritime nation, there is a clear link between shipbreaking activity and economic development. In the mid-1960s, it was advanced nations like the USA and rapidly developing ones, like Japan, that dismantled most ships, with Taiwan and Hong Kong close behind. Taiwan then started to expand, and took over more than half the world's shipbreaking by the end of the 1970s. Rapidly increasing demand in the first half of the 1980s allowed South Korea and China to join in.

Up until this time, then, shipbreaking became a brisk business wherever economic development was strong, leading to a rapidly increasing demand for cheap steel to feed the construction rushes. During the decline in world demand at the end of the 1980s, shipbreaking changed radically and in a way that would be difficult to reverses. With the advent of beaching to South Asia, which made dismantling very much cheaper, former shipbreaking countries found it difficult to compete and have been unable to stage a strong revival of the business—all, that is, except China. Although South Asian conditions are very different from those in East Asia, the cause and effect is much the same: demand for cheap steel during economic expansion leads to a rise in the demand for shipbreaking as a source of raw or part-processed materials.

### 7.2 Sources of Competitiveness in the Shipbreaking Industry

The shipbreaking industry started because of its customers' requirements for scrap and iron plate. Its sole source of raw material is the market for ships surplus to the needs of their owners. For large vessels, this market is international, and shipbreakers can obtain their raw material only by winning a competitive bid. In the South Asian countries of the early 1990s, shipbreakers had almost no fixed equipment, a cheap labor force, and no great expenditure on worker's safety or antipollution measures. This reduced demolition costs significantly, though even these advantages did not justify bids higher than others in the international market. Profits depend on the demand for, and price of, the product—scrap metal, used machinery and other reusable components. If the potential profit is high enough, it is worth bidding higher. Profits are increased, too, if the scrap buyer is not only willing to pay a high price, but is also in the domestic market, and close enough to keep transportation costs down.

Scrap steel plate, the main component of all ships, has special benefits for a developing country undergoing rapid economic growth. The plates are not only very large, and usually of very high quality, but can also be processed without the use of an electric or blast furnace to melt them down. Plate can be reduced to steel bar simply by cutting it to the size required and then rolling it. This material is called "ship plate" and is produced by the "ship plate industry," whose product, even when reprocessed into new articles, is far cheaper to make than the same articles whose steel comes directly from the blast furnace.

Although the ship plate business thrived in Japan and other developed countries until the 1960s, with steel bar as the main output, it has almost disappeared now. The quality of ship plate depends entirely on the quality of the plate chosen when the

scrapped ship was built, so that stable quality of output is hard to achieve. Most of the ship plate became bar steel used as the cores of reinforced concrete, but in Japan, the unpredictably variable quality meant that articles made from ship plate could not to acquire JIS specification. Ship plate was no longer allowed to be used in public construction, and the ship plate business declined rapidly. The same phenomenon—a reduction in demand for cheap steel construction materials—is believed to be responsible for the decline of shipbreaking business in other developed countries.

Growing domestic demand for the iron and steel materials generated from dismantled vessels was making the Taiwanese shipbreaking industry very prosperous by the mid-1980s. For the cost of labor, Taiwan had no particular advantage over other developing countries, and they too produced cheap-to-process ship plate.[4]. When shipbreaking started in South Asia, these countries, too, produced articles of iron or steel from ship plate for use in construction, and shipbreakers prospered from the early 1990s.

As we have seen, the South Asian beaching method lowers the cost of demolition sharply, using labor-intensive dismantling and low investment in equipment. It certainly has problems with labor safety and environmental pollution, but it is a method that many developing countries, elsewhere than South Asia, can easily copy. The most important condition determining the international competitiveness of the shipbreaking industry should be a strong domestic demand for cheap iron or steel materials. As many developing countries encourage economic development by protecting the domestic market so as to promote the domestic steel industry, the shipbreaking industry can gain an advantage from the price difference thus generated between the domestic and international markets for their products.

Taiwan's GDP growth exceeded 10% p.a. in the late 1960s, when it became the world's leading shipbreaking country. Domestic demand for steel construction materials was continuously high in Taiwan, but their import was restricted significantly by tariffs and other non-tariff barriers. China Steel, a state-owned company, started an integrated steel manufacture by blast furnace in the early 1970s, protected in the same way by the government.

The Shipbreaking Business Promotion Association, an incorporated foundation in Japan, found that high domestic demand for ship plate was one of the most important features of countries offering high prices for large scrappable vessels in the early 1980s, such as Taiwan, South Korea, and Pakistan; the domestic price for the plate made it a strong competitor with imported metal.[5] In Taiwan, high domestic prices for ship plate prompted the shipbreakers to bid high in the international market for their raw material.

The protective Taiwanese tariff rate cannot fully account for this price differential between the domestic and international market; this suggest the existence of significant nontariff barriers as well. At that time, the state-owned China Steel Corporation had started operating the first blast furnace in Taiwan, so the government's protective policy for the domestic iron and steel market may have played a significant role for shipbreakers too.

### 7.3 Responsibility for Recycling: Shipowners or Shipbreakers?

A large ship is a mobile object capable of crossing international boundaries. Its flag state does not necessarily indicate its geographical origin or the nationality of its owners, as many ships are registered under flags of convenience simply to save tax. At the end of a ship's life, it is not possible to treat it simply by expanding the rules under which ordinary consumer durables such as home electronics are moved across boundaries and then recycled. For home electronics, for example, the person responsible for correct processing is the generator of the waste, a known subject of a known nation. The same applies to cars—they can move across borders, but each is registered in a specific country whose administration will manage its disposal. It is much less easy to fix responsibility for the disposal of a ship on any individual or even any nation.

Market supply for shipbreakers is unstable. Old ships provide the sole source of supply, and the definition of "old" varies according to the state of the market in international marine transportation. Most large vessels have a useful life of several decades, but it is not predefined. Life can be prolonged by repair or by change to less demanding uses (a luxury liner could be re-used as an inter-island ferry or pilgrim ship, for example). If there is an increase in maritime trade, it is not feasible to build new ships fast enough to satisfy demand, so ships that in normal times would have been scrapped are reprieved, and the shipbreakers' source of supply dries up. If maritime trade suffers a setback, however, shipowners are reluctant to maintain ships that are not generating profit, so they send them for scrap and cause a market glut for the shipbreakers.

Instability is thus an integral part of the shipbreaking market, and observation of it shows that big changes have occurred, not only in numbers of vessels to be dismantled, but in the countries that offer the service. For all the reasons outlined above, it is very difficult to design an international system for recycling. No country can be held responsible for the vessel itself, and each demolishing country sets its own rules. These difficulties suggest necessity need to build an international framework outside the

Basel Convention.

### 7.4 Problems of Large-sized Shipbreaking and Measure for International Treaty

Even before the beaching method prospered in South Asia, shipbreaking was labor-intensive and practiced in a dangerous labor environment where serious accidents, involving loss of life, occurred frequently. In the dismantling yards of Kaohsiung, the Taiwan's main demolition port, a large- accidental explosion killed many workers in 1986 and was a major factor in obstructing the continuation of demolition in Kaohsiung. Even Kaohsiung, however, was much safer, and much less polluting, than beach demolition.

On sand, all the waste oil and other toxic fluids that arrived with the vessel will leak directly into the surrounding environment. The ship's abundant asbestos may impair the laborers' health, and they will not have been issued adequate defenses against that or any other hazards, so they face grave risk of accident. Even when the numbers injured and killed were known, nothing was done to ameliorate the conditions. International organizations, such as the ILO, have issued special warnings inviting attention to this problem of labor safety[6].

Although it was widely known by the 1980s that shipbreaking caused problems of environmental pollution and industrial safety, there was little discussion about international measures or regulation. It was not until the 1990s, when shipbreaking moved from Taiwan to South Asia, that the problems attracted the attention of the international organizations and the international environmental NGOs, and the necessity for action was asserted.

The framework of international regulations for the transboundary movements of hazardous wastes was enacted in the Basel Convention in 1989, and it may have pointed to expansion of the object to the transboundary movements of some types of recyclable materials and used equipments, other than hazardous wastes. Even if the goods dealt carried a value if recycled, they might have been crossing the boundary for the purpose of disposal, and the process of recycling and its residue might cause environmental pollution. The Parties to the Basel Convention have therefore made the transboundary movements of wastes other than hazardous wastes the subject of debate.

For large ships intended for demolition, dealings aiming only at abandonment in the clearly worthless state do not exist. At least part of the ship's main materials can be (and are) recycled usefully and cheaply, having been converted to a saleable form. It is not fair, and may well not even be possible, to place responsibility for a vessel's safe

recycling on its original builder, because it may have undergone many modifications and crossed many boundaries with different owners in different trades.

Starting from this knowledge, international organizations have argued for regulatory measures on demolition of marine vessels and ship recycling—not only in the Conference of Parties of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal in UNEP, but in ILO and IMO. Each has published its own guidelines as a result of the debate: the Basel Convention published "Technical Guidelines for the Environmentally Sound Management of the Full and Partial Dismantling of Ships," in December 2002; the ILO published "Safety and Health in Shipbreaking: Guidelines for Asian Countries and Turkey" in October 2003; and IMO published "the IMO Guidelines on Ship Recycling" in December 2003. The difference between the guidelines of UNEP and of IMO was that the latter offers more practical content from the shipowner's point of view.

However, since none of these guidelines had legal force, so that following them was voluntary and their effectiveness thus limited. In December 2005, IMO decided to base the new treaty on the guidelines of December 2003, from 2008 to 2009. From the above backgrounds, the "Ship Recycling Convention" was adopted at an IMO diplomatic treaty conference held at Hong Kong in May 2009.

### 7.5 The IMO Ship Recycling Convention

The contents of the IMO Ship Recycling Convention are as follows:[7] The objects of regulation are commercial ships of 500 GT or more, and recycling yards operating vessel demolition. On large-sized vessels, by an inspection and issuance of bond, (1) loading of toxic substances is prohibited or restricted, (2) the inventory of loading of the toxic substances should be created and maintained, and (3) preparations for the preceding recycling are to be made. An inventory is a list showing the whereabouts and the estimated amounts of toxic substances in the vessel. Although inventory preparation is not required for a vessel which operates only domestically in its whole life, it will become so when sold overseas. If it is known that the ship will be sold overseas at some time if its life, the inventory will be required at the time of sale, and should therefore have been maintained since the vessel's manufacture. Inventory creation of a naval fleet is confined to nonbinding target.

The Convention charges the recycling yard with duties on security of work safety, proper treatment and disposal of hazardous materials, and the formulation of a ship recycling plan.

The vessel must be disassembled and recycled, only at the authorized recycling yard. Regulations exist for each step of the vessel's life: design, manufacturing, operation, recycling preparation, and demolition. In addition to a first-time and subsequent periodic inspections, the vessel also needs an international inventory bond for each of the steps listed above. For a new ship, an inventory must be created at build time. For vessels already in operation, an inventory must be created within five years after the issue of the Convention. In order to receive issuance of the final inspection and recycling preparation international bond, it is necessary to update the inventory at the recycling preparatory step, and to draw up a ship recycling plan in cooperation with a ship recycling yard. The recycling yard needs to obtain approval as a vessel recycling facility, and needs to undergo periodical inspections by the competent authorities of the country where the facility is located. It must also prepare a ship recycling plan, in cooperation with the shipowner, at the recycling preparatory step.

In an inventory, the fundamental information about the vessel concerned should be indicated. All toxic substances contained in the configuration and apparatus of the vessel are listed in part I of the inventory, created at the time of construction, or for an existing ship. The waste produced during operation, and the harmful supplies left behind in the warehouse, are indicated in part II and part III, respectively, created at the recycling preparatory step. The goods and substances to be indicated in the inventory are classified under four categories from A to D. Table A lists substances like asbestos and PCB, that are prohibited or restricted. Heavy metals, radioactive materials, etc., appear in table B. Table C covers lubricating oil, refrigerants, etc., classified as potential deleterious material. Home electronics, IT apparatus, etc. are listed in table D as common consumer goods.

For an inventory created during the construction of a new ship, each supplying manufacturer submits a material declaration for each step in the preparation of materials, manufacture of components, and assembly. Each component substance is carried forward from the earlier to the later parts of the production chain, according to the flow of material and components, and correlated in the shipyard to create a definitive inventory.

The ship recycling plan drawn up at the recycling preparatory step consists of an occupational safety and public health program, environmental protection program, and recycling process work plan. The occupational safety and public health program includes articles on fire prevention, operational safety of diving operations and the laborers' living environment; the object is to ensure the safety of the laborers and the security of their health. The measures for the management of hazardous materials, such

as the residues of fuels or cargo and heavy metals, are included in the environmental protection program. Technical procedures for implementation of work, such as procedures for disposal of the toxic substances created in process of demolition, demolition itself, handling of steel scrap, laborers' safety, and compliance with environmental protection, are all included in the work plan.

### 7.6 Assignment of Responsibility in Design of Institutional Arrangements

Leading international environmental NGOs, such as Greenpeace, have repeated at every opportunity, including the Conference of Parties of the Basel Convention, their opinion that producers and producer countries should have responsibility for the proper recycling of the vessel. Proper processing at low cost is not necessarily realized by placing the responsibility for it solely on the shipbuilder and the country where the ship was built, for reasons already discussed, and because of the difficulties of, for example, preparing the recycling equipment in shipbuilding countries; such policies cannot be implemented, at least in the short term.

In the IMO Ship Recycling Convention, a system in which many related subjects share responsibility with each stage was adopted. At the manufacturing stage, shipbuilders collect material declarations of raw materials, parts, and machinery from subcontractors, and create an inventory based on that information. Creation of a material declaration should be conducted by subcontractors.

After vessels are handed over, shipowners are responsible for renewing and maintaining the inventory. They also draw up a ship recycling plan in cooperation with recycling yards, before the latter disassembles the vessel. Recycling yards must be approved by institutions organized by the competent authorities of the country where dismantling is carried out, and undergo periodic inspections. A ship recycling plan is drawn up for every individual vessel to be demolished, and suitable recycling should then be carried out.

At each stage of design, manufacture, and operation of a vessel, the competent authorities or shipping classification society of each country inspect the inventory, and issue an international inventory bond. At the recycling preparatory step, just before dismantling, the final inspection of the vessel for demolition is conducted, the inventory is finalized, and a recycling preparation international bond is issued. The ship recycling plan is passed for action and a subsequent inspection is also conducted.

As mentioned above, this system for the recycling of a vessel places responsibility not only on its country of manufacture and builder, but on every person

and body involved with building, operating, and recycling the ship. It is thought that the technical characteristics of vessel served as the background for this recycling system, and that the Scandinavian countries and Japan, historically prolific shipbuilders, oriented the argument during negotiations for the Ship Recycling Convention in IMO. The system of placing the responsibility for recycling only on a ship's country of manufacturer has many difficulties, both technical and practical. The Ship Recycling Convention, therefore, can be said to have been created in such a way that its procedures are both realistic and practicable.

## 7.7 Conclusion and Discussion

The requirements for effectuation of the Ship Recycling Convention are that (1) 15 or more nations conclude, (2) the sum total of the merchant ship tonnage of a contracting State will be not less than 40% (shipowner country provision), and (3) the sum total of the maximum annual demolition bottoms in the latest ten years of a conclusion country becomes not less than 3% of the merchant ship tonnage of a conclusion country (demolition country provision). 24 months after all of these requirements are attained, the Convention goes into effect.

As 15 contracting States are needed, an agreement to conclude by the EU, which has 27 nations, is sufficient. Panama and China add to the ship-owner country provision, and India will conclude as a demolition country, as will China. It is therefore likely that the Convention will satisfy these requirements for effectuation in the near future, and that it will come into effect two years later. The Japanese government will update its own municipal law to agree with that required by the Convention before effectuation of a treaty, so that municipal law can be enforced simultaneously with effectuation. At effectuation time, too, all subject vessels will incur a duty to create and maintain an inventory within five years arises.

It is difficult to tell whether it possible to provide sufficient recycling capacity for all the ships subject to the Convention. It was important for conclusion of the Ship Recycle Convention that India and China lent their support, among the demolition countries. India, which does not demolish as many large vessels as Bangladesh does, are thought, with China, to be bidding for leadership by effectuating the Convention as early as possible. Along with India, Bangladesh, the center of world shipbreaking at and after the beginning of the 1990s, is behind in aligning itself to the Ship Recycling Convention. India and China recognize the Ship Recycle Convention as a chance to expand their share of shipbreaking, and promote maintenance of recycling yards to

fulfill the requirements of the Convention.

However, if Bangladesh, with its big share of world shipbreaking, is overdue, it may become difficult to secure sufficient recycling capacity once the Convention is effectuated.

Although the shipbreaking business has a long history, it has only recently been realized widely that there is a need to build a system for proper recycling. Management across borders is indispensable, as it would be difficult to have individual systems for each country. The IMO Ship Recycling Convention may overcome such difficulty, and is considered to be building a realistic recycling system within a relatively short period of time.

When the history of shipbreaking on and after the mid-1960s is examined, it is clear that shipbreaking boomed during times of high economic growth, when demand for cheap iron and steel articles increased. The business has moved from country to country as each goers through that particular stage of its development. Where domestic demand for ship plate is not great, shipbreaking does not flourish. South Asia is now the center for shipbreaking activities, and can be expected to remain so while demand for ship plate for construction is high.

Under the Convention, the preparation of the recycling system in demolition countries, and the fixed capital investment by demolition contractors will be inescapable, if shipbreaking is to be carried out appropriately, with secure work safety and prevention of environmental pollution. To effectuate the Ship Recycling Convention, full cooperation of all nations, developed and developing, shipbuilders, shipowners and shipbreakers, will be required.

---

[1] For the benefit of insurers, shipowners and other participants in maritime trade, *Lloyd's Register* collects data about the reduction in the total number of vessels in the world, by marine accident or demolition. Gross tonnage (GT) is a unit based on the volume of a vessel, and is used in the shipping industry, the main source of vessels for demolition.

[2] The circumstances of the re-entry to the shipbreaking business of Japan after the 1970s are explained in detail by Sato [2004].

[3] Situations of shipbreaking in South Asian countries are based on Division International Affairs Office, Ministry of Land, Infrastructure and Transport's "Outline of Ship Recycling Convention" [2008], Sato [2004], etc.

[4] Terao [2005] and Terao [2008] investigated the shipbreaking industry in Taiwan, and the factors of its development and decline.

[5] Zaidanhojin Senpaku Kaitetsu Jigyo Sokushin Kyokai (Shipbreaking Business Promotion Association of Japan) [1982: 102-112].

[6] Extensive investigation is not conducted about the substance of shipbreaking of the beaching system currently held in India, Bangladesh, and Pakistan. Material from Greenpeace & FDIH [2005] etc, exists as a report by an international environmental NGO. For ILO measures, see Sato [2004: 45] etc.

[7] Hereafter, explanation of the Ship Recycling Convention is mainly from International Affairs Office, Ministry of Land, Infrastructure and Transport, "Outline of Ship Recycling Convention"[2008], etc. For a description of the IMO (provisional) guidelines, see International Maritime Organization. [2006].

**References**

Greenpeace and FDIH [2005] *End of Life Ships: The Human Cost of Breaking Ships*, Amsterdam: Greenpeace International.

International Maritime Organization [2006] *IMO Guidelines on Ship Recycling: Consolidated Edition*, London: IMO.

Japan Ship Technology Research Association (eds.) [2008] *Ship Recycling: On creation of Inventory, Material Declaration, and Supplier Declaration of Conformity for Newly Build Ships*, Tokyo: Japan Ship Technology Research Association. (in Japanese)

Japan Ship Technology Research Association (eds.) [2009] *Ship Recycling: On the Ship Recycling Convention and Toward Creation of Inventory*, Tokyo: Japan Ship Technology Research Association. (in Japanese)

Lloyd's Register[various years], *Casuality Return*, London: Lloyd's Register.

Sato, Masayuki [2004] *Senpaku Kaitai: Tetsu Risaikuru Kara Mita Nippon Kindai (Shipbreaking: History of Modern Japan from a Point of View of Iron Recycling)*, Tokyo: Kadensha. (in Japanese)

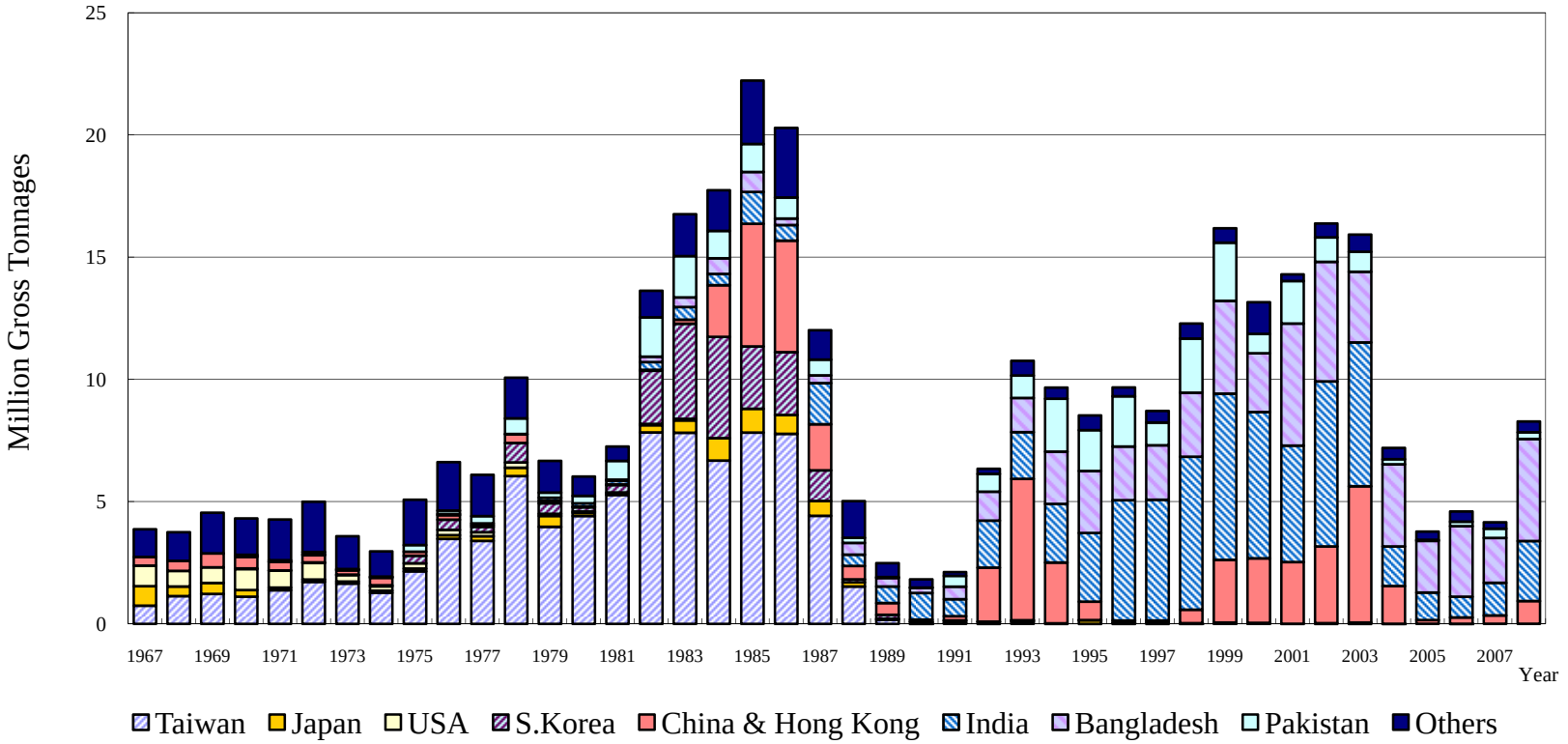
Terao, Tadayoshi [2005], "The Rise and Fall of 'Mixed Metal Scrap' Recovery Industry in Taiwan: International Trade of Scraps and Transboundary Relocation of the Business," in Michikazu Kojima (ed.), *International Trade of Recyclable Resources in Asia (IDE Spot Survey No. 29)*, Chiba: Institute of Developing Economies-JETRO, pp. 63-84.

Terao, Tadayoshi [2008], "Shipbreaking and Metal Recycling Industries in Taiwan," in Michikazu Kojima (ed.), Promoting 3Rs in Developing Countries: Lessons from a Japanese Experiences *(IDE Spot Survey No. 30)*, Chiba: Institute of Developing Economies-JETRO, pp. 59-79.

Shipbuilder's Association of Japan (eds.) [2009], *Shipbuilding Statistics 2009*, Tokyo: Shipbuilder's Association of Japan.

Zaidanhojin Senpaku Kaitetsu Jigyo Sokushin Kyokai (Shipbreaking Business Promotion Association of Japan) [1982] *Kaitetsu Senka no Chosa Bunseki (Research and Analysis on Prices of Vessels for Demolition)*, Tokyo: Zaidanhojin Senpaku Kaitetsu Jigyo Sokushin Kyokai. (in Japanese)

Fig.1 Trend of World Shipbreaking by Major Demolition Countries (1967-2008)




Source: Based on data from Shipbuilder's Association of Japan (eds.) *Shipbuilding Statistics 2009*, and Lloyd's Register, *Casuality Return*, various years.
Note: The data covers commercial ships larger than 100 Gross Tonnages.
Gross Tonnage (GT) is a unit based on the volume of vessel.