

**STUDY OF SHIP BREAKING INDUSTRY AND ITS VALUE CHAIN  
ANALYSIS**

**BY  
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A thesis submitted to the Department of Industrial & Production Engineering, Bangladesh University of Engineering and Technology, Dhaka, in partial fulfillment of the requirements for the degree of Master of Engineering in Advance Engineering Management (AEM).



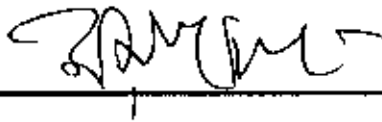
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A thesis titled Study of Ship Breaking Industry and its Value Chain Analysis submitted by Md. Arshad Ali Mondal , Student No:040208105(p) Session April-2002 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master in Advance Engineering Management(AEM) in December 2005.

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## DECLARATION

This is to certify that this work has been done by me and it was not submitted elsewhere for the award of any degree or diploma except for publication.



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**DEDICATED**

**TO MY PARENTS**

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It is to be mentioned that different comments has been made in the report regarding the whole ship breaking process and policy. These are not criticisms rather limitations which can be improved in order to develop the ship breaking process.

Author

## **ABSTRACT**

Ship breaking Industry of Sitakunda in Chittagong is the main source of metal in Bangladesh. This study looks into the process of ship breaking. The study was carried out by visiting the ship breaking yards, interviewing the managers and workers. The study also covered the process how materials from ship breaking is sorted and marketed. It is found from the study that the ship breaking process is quite unorganized. However the material sorting and marketing is considerably organized and efficient. The study found that there are rooms for improvement. The study suggested a scientific sequence of operations based on the concept of the reverse process of shipbuilding. Accordingly an organized layout is suggested for ship breaking. The study also suggested some improvement in the marketing of ship breaking materials.

## **CONTENTS**

		<b>Page</b>
<b>CHAPTER -1</b>	<b>INTRODUCTION</b>	1
	1.1 Objective	2
	1.2 Outline of Methodology /Experimental Data	2
<b>CHAPTER -2</b>	<b>BACKGROUND</b>	3
	2.1 Brief History	3
	2.2 Organization and Related Procedure	4
	2.3 Causes of scraping & marketing	6
	2.4 Factors considered for purchase	7
	2.5 Elements of Ship	8
	2.6 Employment in the Yards	8
	2.7 Facilities of the Employees	10
<b>CHAPTER -3</b>	<b>OCCUPATIONAL SAFETY AND HEALTH</b>	12
	3.1 The Current Situation:	12
	3.2 Safety	12
	3.3 Health	13
	3.4 Effects of substances present:	13
<b>CHAPTER -4</b>	<b>PROCESS OF SHIP BREAKING</b>	20
	4.1 General Process of Ship breaking	20
	4.2 Ship breaking process in Bangladesh	25
	4.3: Value chain of ship breaking	30
<b>CHAPTER -5</b>	<b>SCRAPING &amp; SORTING</b>	33
	5.1 Offshore	33
	5.2 Inter tidal zone	33
	5.3 Beach	34
	5.4 Onshore - final destination	34
<b>CHAPTER -6</b>	<b>SHIP SCRAP MATERIAL MARKET</b>	36
	6.1 Market Players	37
	6.2 Materials Market	38

<b>CHAPTER -7</b>	<b>DEVELOPMENT OF SHIP BREAKING BEST PRACTICE</b>	
	7.1. Better Layout	42
	7.2. Operation Sequence	47
	7.3 Material Sorting	49
<b>CHAPTER -8</b>	<b>DISCUSSION &amp; CONCLUSION</b>	<b>50</b>
	8.1 Discussion	50
	8.2 Conclusion	52
<b>BIBLIOGRAPHY</b>		<b>54</b>
<b>QUESTIONNAIRES</b>		<b>55</b>



## LIST OF FIGURE

<b><u>Figure No</u></b>	<b><u>Description</u></b>	<b><u>Page</u></b>
Figure 2.1	Location of Ship Breaking Industry in Bangladesh	3
Figure-2.2	Main Elements of a typical Ship	8
Figure- 4.1	Big part of a ship is being separated by pulling at beach	26
Figure -5.1	Sorting systems of materials scrapped from old ship	35
Figure-6.1	Relation among sellers, buyers and respective materials.	39
Figure-7.1	Existing layout of an existing yard.	45.
Figure -7.2	More organized layout	46
Figure 7.3	Operation sequence of ship building.	47
Figure 7.4	Operation of ship scrapping.	48

## LIST OF TABLE

<b><u>Table No</u></b>	<b><u>Description</u></b>	<b><u>Page</u></b>
Table-4.1	The Detail operations at different stages of ship breaking with comments	27
Table 4.2	The main materials for specific part of the ship	29
Table 4.3	Value chain of ship breaking process	30

# **CHAPTER ONE**

## Chapter-1 INTRODUCTION



Ship breaking industry of Bangladesh is located on the 10 km long sea-shore along Sitakunda in Chittagong. The industry is the third largest in the world in terms of breaking old ships into scraps, coming next to India and China. The industry comes out on top in terms of breaking the world's largest ships.

Ship breaking industry is the main source of metal in the country. It feeds raw materials for re-rolling mills in the country, contributes 80% of construction iron and employs about 1.5 lac people through its backward and forward linkage. But the ship breaking industry remains largely informal with almost no application of rules and regulations in regards to labors laws, safety measures and overall working atmosphere.

In Bangladesh, the ship breaking industry uses the discarded old method known as beaching method, which is quite harmful to environment. This method is used for quick profit. The ship breaking industry involves dismantling of old ships. There are solid, liquid and gaseous wastes in every old ship. Since there are no proper guidelines for the ship breaking business, there is no system of qualitative assessment of the level of pollution in these wastes.

In the ship breaking yards all the works are done manually and sometimes the workers are forced to work more than their capacity in a short time, which causes major or minor accident very often.

The ship breaking yards are very much polluted by the toxic and metallic fragments and pieces of iron materials discharged from the ships. These are not only dangerous for the workers but also for the local community and the bio-diversity of the ship breaking area.

Apart from construction industry, ship breaking industry is also a major source of raw materials for thousands of engineering workshops around the country. These workshops

need different variety of metal and steel. Most often these workshop collected steel from these ship-breaking yards with out specific knowledge on the type of steel or metal. As a result the engineering products are made of inappropriate type of steel.

Ship breaking industries being the source of metallic materials for the country it would be better if the metallic materials from the broken ships can be scientifically sorted and classified at the source. This would facilitate the subsequent users to collect the right kind of material for design and manufacturing. This study is undertaken to look at the process of ship breaking and the possibilities of arranging the ship-breaking materials into more organized market useful to the downstream users.

### **1.1 Objectives:**

The specific objectives of the study were as under:

- i. To study the present system of organizing the technical processes and safety procedures in ship breaking industry.
- ii. To suggest a better working procedure
- iii. To study the value chain of the whole process
- iv. Analyzing the present system of material marketing and suggesting a new and better system of market organization.

### **1.2 Out line of Methodology/ Experimental Design:**

To meet the objectives, a survey was carried out on the ship breaking industry, collecting data and information from all level of employees (labor to manager) and the owners of ship breaking industry. The present metal market was visited and the dealers were interviewed. Also the end-users like re-rolling mills, light engineering workshops and cable industries were visited and interviewed. Visits and interviews were supported with structured and unstructured questions prepared beforehand. The responses were recorded verbatim.

## **CHAPTER TWO**

## Chapter-2 BACKGROUND

### 2.1 Brief History:

In Bangladesh, ship breaking is popularly known as 'beaching'. Ship breaking started as a business in Bangladesh in 1972. Prior to that, 2/3 ships were scrapped during Pakistan period. It started automatically when a 20,000 D.W.T. vessel was driven ashore by the devastating tidal bore of 1965. That was the first ship scrapped on the Chittagong Sea beach. At present ship-breaking is conducted by 32 Ship breaking Yards in an area stretching about 10 km from a point near *Baro Awlia* under Sitakundu police station of Chittagong. All the yards are located on the beach of the Bay of Bengal. Figure 2.1 shows the location of ship breaking industry in Bangladesh.

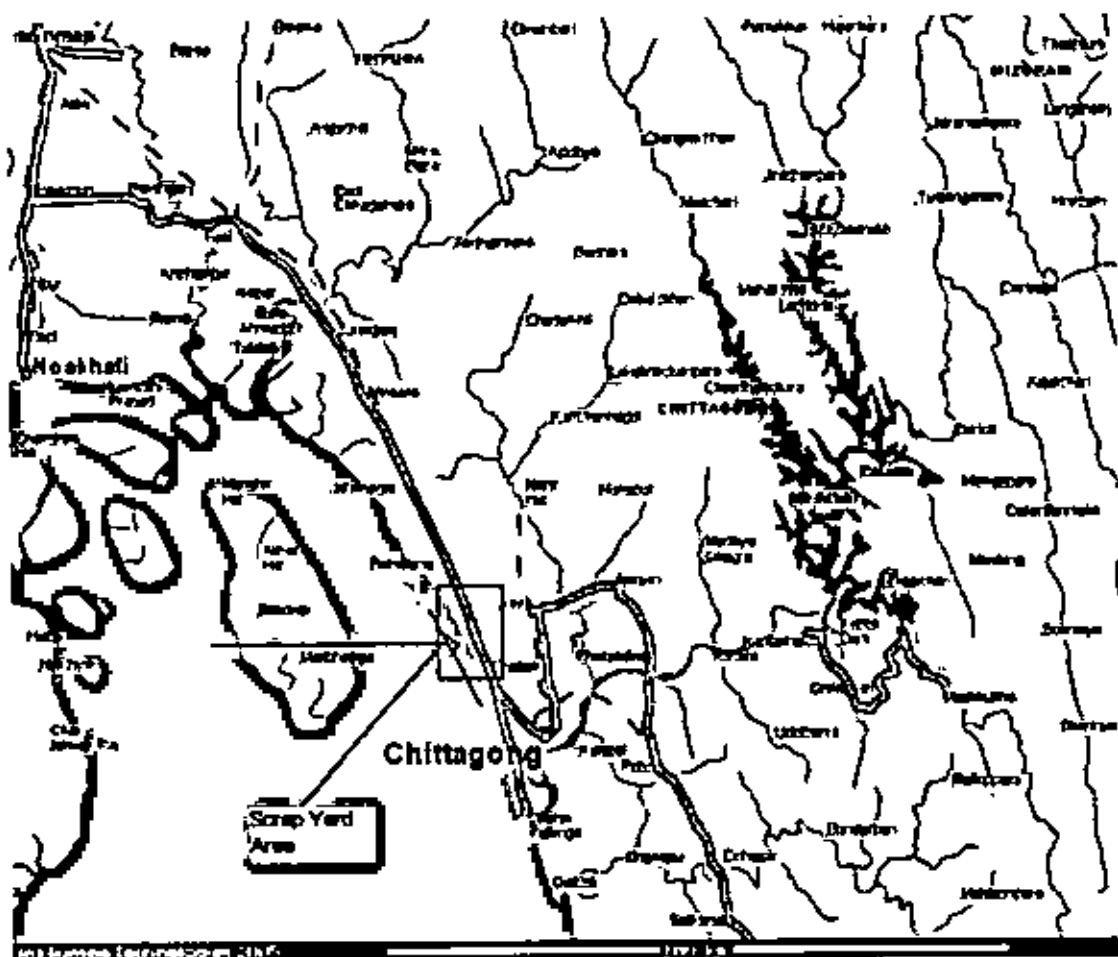


Figure 2.1: Location of Ship Breaking Industry in Bangladesh

The overall conditions of all the ship breaking yards are almost the same. Ship breaking is done in open yards on the beach of the Bay. They are not scientifically or technically organized and the management is also primitive. The Ship-breaking yards look like temporary arrangements to conduct some seasonal activities, though ship breaking continues round the year. Workers are not protected by sheds and are required to work under open sky round the year in very difficult working conditions exposing themselves to various hazards.

## **2.2 Organization and Related Procedure:**

Though the Ministry of Port and Shipping and Ministry of Industries are the two Ministries directly responsible for monitoring and supervising the ship-breaking enterprises, the following government and non-government bodies are also involved in ship-breaking activities:

- i. Ministry of Labour and Employment
- ii. Department of Customs
- iii. Bangladesh Navy
- iv. Inland Water Transport Authority
- v. Chittagong Port Authority
- vi. Radio Communication and Wireless Control Authority of the
- vii. Shipping Masters Office
- viii. Importers (Who import vessels for breaking)
- ix. The Breaking Yard Owners and Breakers
- x. Survey Authority
- xi. Survey companies
- xii. Banks & financial Institutions
- xiii. Shipping Agents
- xiv. Steel Re-Rolling Mills Owners
- xv. Traders

Initially, beaching permission was not necessary. The Breakers had to maintain only the import formalities and pay customs duties and taxes. The number of ships imported for scraping during the period 1972-1982 was very limited. It was observed that the marine

stores, life saving and fire fighting equipment of scraped vessels which were either obsolete, sub-standard or not in proper condition, were sold on the market and re-used in the ships in service, which may cause serious problems any time during voyage on deep sea. So, the Mercantile Marine Department issued circulars to all ship breakers restricting the sale and re-use of the above items.

In the Merchant Shipping Act 1884, procedures are laid down with regards to marine stores, cables, anchors and marine engine etc. Instructions are also laid down in the above Act with regards to breaking of vessels. But it was observed that ships are brought for breaking without maintaining such formalities, safety measures and legal provisions.

No sound technical system is used to recover valuable stores, spares, metals and other items from the ships. On arrival of ships at outer anchor of the Chittagong Port, agents of shipping companies book a towing vessel from the Chittagong Port Authority for towing the vessel to the shore. The Port officials before towing the vessel verify the import documents, document on payment of duties/ taxes and certificates issued by the concerned Government authorities. One Deck Officer and one Certified Engineer, in addition to the Master of the vessel need to be present during beaching operation of a ship. Then Bangladesh Navy comes for inspection of the ships and prepares a complete inventory of communication equipment, radios, wireless sets, walkie-talkies, transceivers, engines etc. As per law of the land, the walkie-talkies and wireless sets are subject to be handed over to the Wireless Board of the Government immediately after completion of beaching of the ships. Meanwhile, the Mercantile Marine Department conducts surveys to check the safety measures taken and also checks the marine stores and a list is prepared. The Mercantile Marine Department surveyors also verify all the documents of the vessels.

The Ministry of Ports, Shipping and Inland Water Transport Authority and the Ministry of Industries and Commerce of the Government of the Peoples Republic of Bangladesh, control the import and beaching of ships. The Department of Inspection for Factories & Establishment of the Ministry of Labour and Employment is responsible for according registration to the yards as factories (industries). The Department of Inspection is also responsible for ensuring occupational health & safety, safe-working conditions,



working hours, leave with pay, holiday etc. of the ship breaking enterprises. The Department of Labour is responsible for workers welfare, trade union rights and industrial relations etc.

### **2.3 Causes of Scraping and Marketing:**

The life of a steel vessel is usually 20 years. Whatever conversion or modifications might have been carried out, it cannot be extended beyond 25 years. Steel used for building a vessel must sustain fatigue due to rolling and other reaction during voyage. The International Maritime Organization, therefore, has fixed 25 years as lifetime for a vessel. The ship owners find it profitable to declare a vessel unfit for service on the expiry of 20 years life span than repairing and modifying the vessel for further voyages. Starting from the Second World War, steel body vessels are the main means of transport of goods internationally. Insurance coverage of cargo is a very important factor for the consignees. Insurance companies hesitate to provide insurance coverage to cargo booked on a ship of over 20 years of age. So, procuring cargo or business for the over aged vessels becomes difficult. At this stage ships are declared, unfit and unserviceable, and are sold for scraping. Parking of unserviceable vessels in harbor area is also costly and tedious.

The scraping work needs huge labour and capital; scrapping operations involve high risks and problems. So, the owners of the vessels prefer to sell out the unserviceable vessels to the countries where there is demand for scrapped steel and other items of old ships, labour cost is relatively low, and there is less concern about hazards, toxicity and environmental pollution. Thus, ship owners who want to get rid of their unserviceable vessels contact the concerned business community of nations who look for cheaper steel and other items of the ships. These two parties transact a good business of selling and buying of unserviceable vessels at a point. Unserviceable vessels are sold on the basis of lightweight tonnage (LDT) of the vessel. A ship is measured mainly on the basis of its Dead Weight capacity. Dead weight of a ship is defined as weight of cargo plus fuel and consumable stores while light weight of a vessel is the weight of the hull including, machinery and equipment. The length, breadth, depth, and displacement are also very important factors for buying and selling of an unserviceable ship. Present international rate for sell of vessel is US\$425 per lightweight tonnage (LDT).

## **2.4 Factors Considered for Purchase:**

The Bangladeshi Traders and ship breakers purchase dead/unseaworthy vessels or ships in running conditions from different parties at different points and bring those to Bangladesh for beaching. The ship breakers purchase the vessels of their choice. Nationality of the owners of the vessels or the country of origin of the ship is not a factor of consideration but they take into account the following points during purchase of the ships:

- i. Light weight tonnage of the vessels (LDT).
- ii. Cost of the voyage to the beaching site of the ship.
- iii. Probable towing cost in the case of dead vessel.
- iv. General stores that may be available.
- v. Miscellaneous materials that may be available.
- vi. Condition of the re-useable marine stores.

From various sources, such as the Ship Breakers Association, ship breaking enterprises and the Govt. agencies, it is gathered that generally the following three types of vessels are demolished in the Chittagong Ship Breaking Yards.

- i. General cargo vessels.
- ii. Tankers.
- iii. Bulk carriers.

Bangladesh breakers prefer to demolish the above types of vessels for reasons, such as availability of profitable items, safe and easy breaking operation and safe journey of the vessels to beaching site. The main sources for purchase of unseaworthy vessels are the former USSR, Bulgaria, Romania, Greece, Italy, Turkey, Japan, Singapore, South Korea, etc. Towing of a dead ship for scrapping is costly, so the Bangladeshi ship Breakers and their agents generally prefer to buy ships on voyage or ships stranded at a port near Chittagong, i.e., located at any port of India, Sri Lanka, Myanmar, Thailand or Singapore.

## 2.5 Elements of Ship:

Figure 2.2 shows the elements of a ship. Generally 95% of a ship's body is made of mild steel (M.S.), 2% of stainless steel and 3% of miscellaneous metals, such as brass, aluminium, copper, gun metal and other alloys which are important factors of ship breaking.

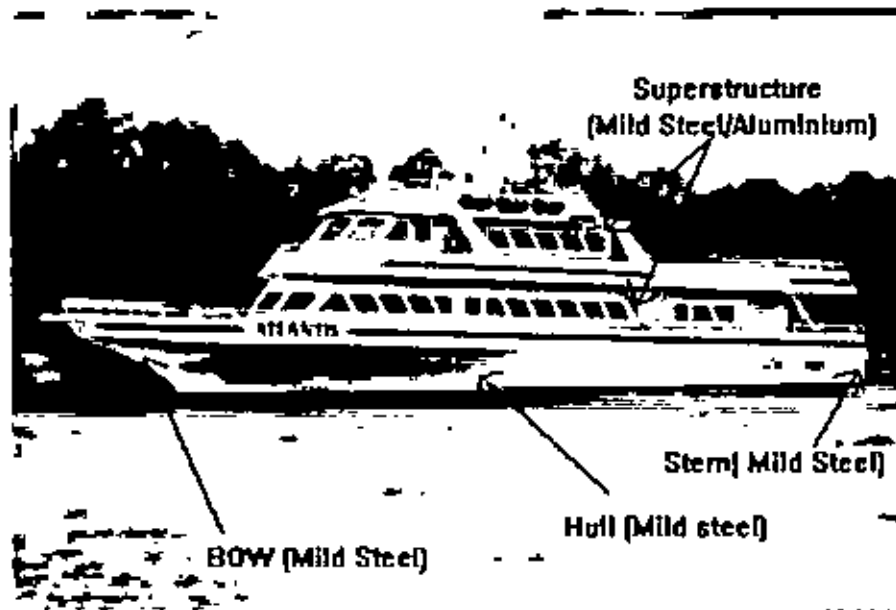


Figure-2.2: Main Elements of a typical Ship

Stores and other materials that may be available from a ship purchased for beaching are also considered very important. In fixing the price of a ship, consideration is given to the factor of whether it is a dead ship or a running one. Ships store ranges from foodstuff to clothing, from electrical to electronics, machinery of most type, life saving equipment, drugs, communication equipment, furniture etc.

## 2.6 Employment in the Yards:

In Ship breaking Yards, employers employ two major categories of employees and workers. They are:

- I) regular employees and workers;
- II) Casual workers supplied by the Labour Supply Contractors.

The regular employees and workers are paid monthly wages; including house rent allowance, medical allowance and conveyance allowance. This category is also paid an extra allowance for overtime work. This first category includes skilled workers like:

1. Foremen/Supervisors

2. Fitters (they are engaged to dismantle important parts, pipes, hardware, metal etc. of the vessel).
3. Gas cutters (highly skilled)
4. Crane operators
5. Truck drivers
6. Rhythmic callers/singers. (He goes on singing to synchronize steps of the group of casual workers while carrying heavy steel plates and pipes etc. from one place to another; their role is highly important).

The second category includes Semi skilled & unskilled workers like:

1. Truck helpers
2. Semi skilled gas cutters
3. Semi skilled Fitters
4. Lifters
5. Loaders
6. Wire pullers
7. Cutter, loading & wire pulling helpers.

The second category of workers is mostly engaged through Labour Supply Contractors, and paid on a daily rate basis. Service records of all types of workers under the first category should be maintained by the employers, while records of the workers supplied by the Labour Supply Contractors are not maintained by the employers. Casual workers work under the contractor's supervision. Apart from workers there are two types of security guards in Ship breaking yards. These are:

- I) Guards engaged on regular basis by the enterprise;
- II) Deployed by the Department of Ansar (Para-military forces), Government of Bangladesh on demand and on payment.

Ship breaking is a regular production process but not in conformity of normal manufacturing processes. The number of workers engaged in the ship breaking yards depends on the availability of work, size of the ship to be scraped and market value. The number of skilled workers and security guards remain static while the number of semi- skilled and unskilled workers varies as per need. In 32 ship breaking yards approximately 2000 regular workers (skilled-clerical-commercial and security personnel) are working on monthly wage basis; about 25,000 workers of semi and unskilled categories, work in the above mentioned ship breaking yards round the year,

on a daily wage basis. Workers even migrate from one yard to another when a yard owner changes the labour contractors or the labour contractors change the yards. This normally happens when the demand for workers increases. Yard owners even allure skilled hands from other yards by offering better wages and service conditions. Mainly gas cutters are considered to be the most valuable workers in ship breaking enterprises. The unskilled workers are divided into gangs of 25 including one supervisor, one singer/synchronizer and one on-looker.

## **2.7 Facilities of the Employees:**

Most of the large ship breaking yards provide accommodation to the workers. Generally, skilled workers, supervisors and office staff live in rented houses near the yards. A good part of them lives with their families. At least 50% of the semi-skilled and unskilled workers live in the labour sheds built by the owners. The accommodations provided by the owners are not suitable and hygienic, but it is safer for the workers to be accommodated in protected areas within the yards and this is also advantageous for the employers.

Bangladesh Factory Act 1965 provides that there should be sufficient supply of pure drinking water in a factory employing more than 250 workers. As the yards are located away from the city area, so workers get drinking water from the tube wells sunk in each ship-breaking yard.

Wages and pay of the employees of Ship breaking yards as well as their working hours and overtime are not in full conformity with the law of the land. The employees, such as clerks, supervisors, foremen, master cutters are paid monthly wages ranging from Taka 3000 to 5000 (US\$60-100), inclusive of house rent, medical allowance etc. Many of the skilled cutters, unskilled workers and general labors are engaged on 'no work no pay' basis. They receive 70 to 80 Taka a day for every 8 hours of work. For overtime work, these workers receive extra wages on single rate basis, while the law prescribes double the rate of the normal wages for extra hours. Similarly, workers who work on weekly holidays are not entitled to any holiday pay or any benefits in lieu. Breaks for taking meals are allowed. Since workers do not benefit from mandatory holidays as per law, they cannot expect any allowance or facility.

Employer is to provide welfare facilities for the workers. However, the workers are not provided with proper washing facilities and canteen facilities in the yards. So, workers are compelled to go to the nearby shops and tea stalls. Availability of mess or rest room is out of question.

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## **CHAPTER THREE**

## **Chapter-3**

# **OCCUPATIONAL SAFETY AND HEALTH**

### **3.1 The Current Situation:**

The associated procedures and processes associated with decommissioning for scrapping and disposal/recycling induce exposure to surroundings involving hazardous substances and dangerous/harmful situations and operations. The effects of such exposure are generally well known and documented in other comparable industries. Manual, low-paid unskilled workers are allowed to dismantle the ships and undertake the reprocessing/recycling operations without the provision of personal protective safety equipment. Scant attention is paid to health and safety issues and there is generally no systematic training of the workforce. Consequently, injuries and deaths are commonplace.

Housing and sanitary conditions are aggravated by provisional arrangements at the sites often put together with materials from the scrapping process. Health services and social welfare are non-existent or insufficient. Environmental concerns are low on the agenda of both management and the workforce, with little or no attention paid to the pollution occurring as a result of their activities or to the harm this may cause when the pollutants enter the environment and food chain.

### **3.2 Safety**

The working conditions are influenced by a surrounding characterized by large unsafe structures and the introduction of several simultaneous operations within a small area involving many individuals. Accidents causing injuries or deaths originate due to absence of:

- Skills;
- Appropriate plans and working procedures;
- Precautions including the use of personal protective safety equipment;
- Lack of facilities and safe working platforms and tools.



### **3.3 Health**

There are little or no available data or reports on workers' health. This suggests that there is no, nor never has been, any systematic monitoring of health among workers engaged in ship scrapping in these regions.

Workers are exposed to situation, which is potentially negative for their health due to the working procedures adopted such as:

- Torch cutting without protection (eye injuries);
- Heavy lifting (wear and tear, back injuries);
- Noise (hearing defects); and from the exposure of hazardous substances such as:
- Chemicals (PCB, PCV, PAH, tin-organic compounds (TBT), oils and gas);
- Asbestos;
- Heavy metals;
- Fumes (dust, fume/gas components: dioxins, isocyanides, sulphurs, etc.);
- Mobile fire extinguishers contain either water or sodium bicarbonate (baking powder).

These chemicals will not have any environmental effects in case of discharge. Although in general the toxicity of the powders used is low, they are unpleasant to breath and can cause respiratory tract injury if inhaled in sufficient quantity.

### **3.4 Effects of substances present:**

Substances resulting from the demolition process may cause direct and indirect threats to health and/or to the environment. They may also have long-term effects due to accumulation and/or by entering into the food chain.

#### **3.2.1 Health and Environment:**

The following provides an initial insight into potential threats to health and to the environment in relation to scrapping caused by the presence of hazardous substances.

### **3.2.1.1 PCB – Polychlorinated biphenyl:**

PCBs (polychlorinated organic compounds containing two benzene rings) were first produced on a commercial basis in 1929 and have been used in printing inks, as a softener in plastics (floor coverings, gaskets) and as insulators in transformers/capacitors. It may be found in glues, sealing materials and cable insulation. PCBs are highly toxic and will bioaccumulate and persist in the environment.

Exposure to PCBs has been associated with a variety of adverse health problems. PCBs have been linked to cancer, liver damage, reproductive impairments and immune system damage. Exposure has also been linked to behavioral damage and neurological damage. Occupational exposure studies have provided further evidence that PCBs are dangerous to human health. Workers at a capacitor manufacturing facility in the US showed an increased mortality rate as a result of specific cancers. Although overall mortality rates were not elevated, a statistically significant excess of deaths due to liver and biliary tract cancers was observed. Recently, the US Environmental Protection Agency classified PCBs as a carcinogen.

### **3.2.1.2 PVC (Polyvinyl chloride)**

PVC is used in a wide variety of products for different applications and commonly found in cables, floor coverings and plastic devices of different types. PVC contains more than 50 per cent chlorine. When burnt, combustion products of extreme complexity are produced consisting of several hundred compounds. The combustion of PVC produces large quantities of hydrogen chloride gas. If inhaled, this can react with water vapors and humidity and form hydrochloric acid in the lungs. A fluid build-up leading to possible ulceration of the respiratory tract can be the result. In addition, the burning of PVC products produces carbon monoxide, dioxins and chlorinated furans. Dioxins are among the most toxic substances known. Some congeners are toxic at concentrations below 10-12g m<sup>3</sup> in air.

Dioxins and furans are two of the most toxic products known because the dose that can cause disease is lower than that for any other man-made chemical. They are linked to

cancer and birth defects. These highly toxic substances are either inhaled directly or deposited on soil, water and in crops and thereby threatening the food chain.

### **3.2.1.3 PAHs (Polycyclic aromatic hydrocarbons)**

PAHs are composed of two or more benzene rings. Approximately 250 different PAH compounds are known. Some 30 PAH compound and several hundreds of derivatives are classed as carcinogenic. This makes PAHs the largest single class of carcinogens known today.

PAHs can be formed by incomplete decomposition of any organic material containing carbon and hydrogen, e.g. oil products and residues. The combustion of oil may also lead to the formation of PAHs.

The biological degradation of PAHs decreases normally with increasing molecular weight (more difficult to break down PAHs with increasing number of benzene rings). They are persistent and have well-documented serious long-term effects both from the environmental and from a health perspective.

### **3.2.1.4 TBT (Tributyltin)**

TBT is an organ metallic substance that can have effects at very low concentrations – sub-nano gram quantities per litre. These are mostly related to impose, e.g. in gastropods and thereby the balance in the ecosystem. TBT is therefore considered to be one of the most serious toxic compounds in the aquatic environment. Its use is now strictly controlled in most parts of the world. However, it is still the most commonly used anti-fouling product and will continue its dominance until the International Maritime Organization (IMO) TBT ban is in place (2008).

TBT, which is one of the active components in anti-fouling (used to reduce ship resistance by preventing hull fouling), has been found to be extremely toxic to various aquatic organisms, particularly to larva and the juvenile stage of oysters and fish. It has also been found that TBT accumulates in the sediment and bioaccumulates in mollusks.

### **3.2.1.5 Oils and Hydrocarbons:**

Hydrocarbons such as crude oil and refined petroleum products are complex Substances consisting of numerous different compounds. Alkanes and aromatic hydrocarbons are the main classes of hydrocarbons in crude oil, where the former have low toxicity and the latter include environmentally harmful polycyclic aromatic hydrocarbons (PAHs). Also other hydrocarbon components in the crude oil, e.g. alkylated phenols and declines can have detrimental effects on the marine environment and human health.

### **3.2.1.6 Asbestos:**

Asbestos-containing material (ACM) may be found in thermal system insulation and on surfacing materials. Some other applications may also be found. When ACM deteriorates or is disturbed, asbestos breaks up into very fine fibers that can remain suspended in the air for long periods and possibly inhaled by workers and operators at the facility or by people living nearby. The most dangerous asbestos fibers are invisible. Once they are inhaled, the fibers can remain and accumulate in the lungs. Breathing high levels of asbestos fibers can lead to an increased risk of lung cancer, mesothelioma (a cancer of the chest and abdominal linings), and asbestosis (irreversible lung scarring that can be fatal). Symptoms of these diseases do not show up until many years after exposure. Most people with asbestos-related diseases have been exposed to elevated concentrations in connection with their work.

### **3.2.1.7 Heavy metals:**

Metals of concern associated with the ship-breaking industry are toxic heavy metals such as lead (Pb), mercury (Hg) and cadmium (Cd). These are biologically non-essential metals that can cause harm to human health and/or ecological systems. Other metals in the breaking industry are iron (Fe) alloys (steel), aluminium and zinc (Zn). The metals can be found in many products onboard a vessel in varying quantities. Steel on the one hand is present in very large quantities, while mercury in most cases only occurs in very small amounts (in paints, batteries and instrumentation).

### **3.2.1.8 Mercury (Hg):**

Hg is a toxic heavy metal and a persistent, bioaccumulative pollutant that affects the nervous system. On board ships, mercury can be found in thermometers, electrical switches, level switches and light fittings. Accidental spills of mercury can lead to

dangerous mercury exposure. Consumption of contaminated fish is also an important route of mercury exposure. Mercury must be handled as hazardous waste according to national regulations.

#### **3.2.1.9 Lead (Pb):**

Lead (Pb) is toxic, and is found in batteries, paints and in components in motors, generators, piping, cables and others. The deleterious effects of lead upon human health have been commonly known for a long time. Young children are most vulnerable to its toxic effects. Long-term exposure to even low levels can cause irreversible learning

difficulties, mental retardation and delayed neurological and physical development. In adults, exposure to lead affects primarily the peripheral nervous system and can cause impairment of hearing, vision, and muscle coordination. Lead also damages the blood vessels, kidneys, heart and the reproductive system.

Lead chromate (present in paint pigments) is documented as a carcinogen both to humans and other organisms. It may also damage embryo development and cause infertility. Improper disposal of batteries and paints containing lead can cause a threat to health as well as to the environment.

#### **3.2.1.10 Copper (Cu):**

Cu is an essential trace metal which is widely used in the transmission of electricity, paint, alloys and pipe work. Elevated copper levels have been detected in marine organisms but the effect of accumulated levels is uncertain. Copper is highly toxic.

#### **3.2.1.11 Zinc (Zn):**

Zn is handled in large quantities at scrapping sites, mainly due to widespread usage in anodes. There is a possibility that dissolved impurities in zinc anodes such as Cadmium (Cd) and Pb can have an adverse effect on the environment. However, the concentrations in the anodes are relatively low compared to the total amount of zinc.

#### **3.2.1.12 Aluminium (Al):**

Al is present in large amounts in anodes but does in this form not represent any acute pollution or toxic source of major concern.

#### **3.2.1.13 Iron (steel)**

Steel does not in itself represent a problem to human health. Scrap steel will contain a considerable amount of coatings and paint products. These are exported from the scrapping site to the steel recycling facilities. Their discharge to the air following steel recycling may contain toxic gas components.

#### **3.2.1.14 Other substances:**

**Isocyanides** are often used in processes such as spray-painting and polyurethane coating. Occupational exposure can cause respiratory diseases such as asthma. The exposure levels likely to be generated by ship scrapping activities are unknown.

**Sulphuric acid** is corrosive and can cause severe burns (skin/eyes). However, any sulphuric acid spill, will most likely be of small amounts. If batteries are undamaged, they will not have an environmental effect. However, if batteries are stacked in piles, accumulated leakages can become considerable and should be a cause for concern. The CFC class of compounds (chlorofluorocarbon) contains only carbon, chlorine and fluorine. Freon were developed in the 1930s as a non-toxic, non-flammable and chemically inert refrigerant replacement for sulphur dioxide and ammonia. The chlorine and fluorine in CFCs have the potential of depleting the ozone layer and thus reducing the protection from ultraviolet-B radiation. Ship borne CFCs are believed to contribute 10 per cent of the global emissions.

**Radioactive material** may be present on board a ship in liquid level indicators, smoke detectors or emergency signs. These sources generate low-level radioactive waste, but handling and disposal of such waste is usually strictly regulated. Ionizing radiation is hazardous to human health and the environment and can cause severe forms of cancer and/or damage to genetic material endangering future generations. Any release of radioactive material could increase the radiation exposure to the population and must therefore be avoided.

Ballast tank sediments constitute a large amount of organisms including viruses and bacteria that can be a threat to both human health and to the environment. The discharge of ballast water sediments has previously been connected to the outbreak of cholera epidemics.

## **CHAPTER FOUR**



## Chapter-4

# PROCESS OF SHIP BREAKING

### 4.1 General Process of Ship breaking

Ship breaking is any breaking down of a vessel's structure to dismantle the vessel, including the removal of gear, equipment, or any component of the vessel. This term is commonly referred to as "ship scrapping" and "ship disposal." As ship that is to be broken up is said to be "sent to the breakers".

Ship dismantling is a manual process that does not lend itself to automation. The result is substantially higher labor costs for ship scrapping activities. The obsolete equipment on military ships has little or no value in today's markets, resulting in substantially less revenue for the scrap recycler.

#### 4.1.1 Ship breaking Procedures:

The skills required to dismantle a ship are a unique blend of technical knowledge and physical labor. Technical knowledge is needed to properly eliminate hazardous materials and safely remove heavy sections of steel hulls. Ship scrapping is still a labor-intensive process with much of the work being done using hand held cutting tools.

The two methods of scrapping a ship are the afloat method and the dry-dock method. The afloat method is generally less expensive than the dry-dock method, but this cost savings comes with greater difficulty than the dry-dock method. Scrapping a ship while in the water is more difficult because of the scrappers need to strip the inside of the ship before dismantling can begin. Workers must strip the interior through doors and hatches and remove the propeller(s) and rudders while the ship is in the water. Then, the scrappers remove the superstructure and topside components and progressively cut the main and lower decks from bow to stern. As they remove material from the ship it becomes lighter and is pulled ashore, a little more each day, with each high tide. Scrapping a ship in a dry dock is more expensive, yet it is easier to scrap the vessel. Since the ship is not in the water, the workers can immediately begin separating the

vessel into large sections, and then move the large sections to other areas to be cut into smaller sections.

Ship scrapping consists of removing mechanical, hydraulic or electronic components that have potential market value for resale or reuse and then physically cutting the remainder of the hull to allow the recycling of metals and other material by sale to salvage yards or smelters. After salvageable equipment has been removed from the ship, the dismantling begins. The interior spaces are cleared to allow the hull structure to be cut apart. Components within the compartment, such as piping, electrical cables, lockers, partitions, furnishings and habitability equipment, are cut and removed. Heavy steel hull and structural materials are cut with hand held gas torches and saws. The majority of the hull sections cut from the ship are less than 10 tons in weight, allowing them to be handled by a variety of common cranes and lifting equipment. Non-reusable equipment, wiring, piping, and non-structural material are cut free using saws, grinders, abrasive cutting wheels, and hand held shears, plasma and gas torches. Non-recyclable material is disposed of as waste in accordance with the applicable regulatory requirements. The need to remove hazardous materials such as asbestos, lead, PCB's, residual fuels and other liquids makes ship scrapping in compliance with all the applicable environmental regulations a challenging task.

After removal from the fleet site, a ship is towed to the site where ship scrapping will occur. The ship is then scrapped while either moored, beached, or in dry dock. Most ship scrapping is performed at slips, which are dredged openings in the bank of the ship channel. Slips are generally 400 to 700 feet long and 100 to 120 feet wide at the entrance. A large winch at the head of the slip is used to drag the hull farther into the slip as work progresses. The scrapping process usually occurs in a series of steps:

A diagram of all rooms, compartments, tanks, and storage areas is used (or prepared if not available) to identify areas that may contain hazardous materials, such as fuels, oils, asbestos, PCBs, and hazardous waste. Preliminary sampling of media is conducted, starting in the compartment that will be cut first.

The removal of fuels, oils, other liquids (e.g., bilge and ballast water), and combustible materials from the ship generally occurs throughout the ship scrapping process. The U.S. Coast Guard requires booms around the ship to help contain any spills. Following

removal activities, a marine chemist is contracted to certify that the ship is safe for workers or safe for hot work allowing the issuance of hot work permits. Hot work permits allow cutting torches and saws to be used to dismantle the ship. During the ship scrapping process, water will continue to accumulate and will have to be removed.

Fixtures, anchors, chains, and small equipment are removed initially. Large reusable components (e.g., engine parts) are removed as they become accessible. Reusable materials and equipment may be sold directly with little or no refurbishment by the scrapping facility. Propellers may also be removed so the hulk can be pulled into shallow water.

Asbestos-containing material (ACM) is removed from cut lines so that large sections of the ship can be removed. The engine rooms usually contain the most asbestos and, therefore, take the longest for asbestos removal to be complete. PCB-containing materials that are accessible are removed, as well as PCB-containing materials from areas to be cut. Some PCB-containing materials may be left in place on the room-sized pieces, only to be removed after the large piece is moved to shore.

Following asbestos and PCB removal, paint is removed, if required, from surfaces to be cut. The presence of hard-to-remove and potentially toxic materials may require specific cut-line preparation, such as grit blasting.

During the cutting phase, the upper decks and the superstructure and systems are first cut, followed by the main deck and lower decks. Metal cutting is typically done manually using oxygen-fuel cutting torches, but may be done with shears or saws (for nonferrous metals). Typically, as large parts of the ship are cut away, they are lifted by crane to the ground where they are cut to specific shapes and sizes required by the foundry or smelter to which the scrap is shipped. As cutting continues and the weight of the structure is reduced, the remaining hulk floats higher, exposing lower regions of the hull. Bilge water is sampled and discharged appropriately. Ultimately, the remaining portion of the hull is pulled ashore and cut.

Scrap metals, including steel, aluminum, copper, copper nickel alloy, and lesser amounts of other metals, are sorted by grade and composition and sold to remelting firms or to scrap metal brokers. Valuable metals, such as copper in electric cable, that

are mixed with nonmetal material may be recovered using shredders and separators. The shredders produce a gravel-like mixture of metal particles and non-metal "fluff". The metals are then separated from the fluff using magnetic separators, air flotation separator columns, or shaker tables. Fluff is a term used in the recycling trade for solid and liquid non-recoverable, nonmetallic materials obtained during the ship scrapping process. Fluff is not salable. Because it contains regulated hazardous waste (e.g., asbestos, PCBs, hydrocarbons), it must be managed and disposed of according to the hazardous waste regulations.

Machinery components are typically removed throughout the scrapping process. During the preparation phase of scrapping, small articles and the propellers are removed which allows the hulk to be pulled into shallow water where scrapping usually takes place. As layers of the ship are cut, large reusable or recyclable components are removed as they become accessible.

When removed from the ship, ship machinery components are typically handled in the shipyard, or what is commonly called the scrap yard. These components, which may be stripped of valuable materials and/or cut into smaller pieces, may contain or be contaminated with hazardous materials, including asbestos, polychlorinated biphenyls (PCBs), oils, and fuels.

Other materials that are not recycled, including hazardous materials and other wastes, are disposed of according to applicable laws and regulations.

#### **4.1.2 Ship breaking and Scrap Metal**

Metal cutting is the process of cutting a ship apart for the recovery of materials, including several grades and types of scrap metal (see below). During ship scrapping, the upper decks (i.e., the superstructure) and systems of the ship are cut first, followed by the main deck and lower decks. As large parts of the ship are cut away, they are lifted by crane to the ground where they are further cut into the shapes and sizes required by buyer (e.g., smelter, scrap metal broker). As cutting continues and the weight of the structure is reduced, the remaining hulk floats higher exposing lower regions of the hull for cutting. Finally, the remaining portion of the hull is pulled ashore and cut into sections.

The metals on ships are typically cut using a variety of torches and mechanical cutters. While not as common as torches or cutters, some facilities employ the use of detonation charges to cut ship hulls.

An oxygen fuel torch is the tool of choice for cutting steel. It burns a wide variety of fuel (e.g., acetylene, propane, butane, fuel gas, natural gas) and uses either oxygen (liquid or compressed) or liquid air as the oxidizer and "cutting gas" that serves to burn (oxidize) iron along the cut line. Oxygen-fuel torches operate with a flame temperature of 3,500E- 4,000EF and flame velocities of 290 - 425 feet per second. Dozens of different styles of torches and torch tops are available depending on the type and supply pressure of the fuel and oxidizer, the thickness of the metal to be cut, and the environment where the work is done. The cutting speed of these torches ranges from 17 to 26 inches per minute depending on the steel thickness, fuel, oxidizer, and torch tip.

Electric arc or plasma arc torches generate temperatures high enough to liquefy almost any metal by the discharge of electric arcs. A cutting gas, often air, is used to blow away the molten metal. Manual electric arc torches are much slower than oxygen-fuel torches, cutting at rates of no more than 10 inches per minute.

Large industrial shears can quickly reduce large metal parts to small dimensions suitable for a remelting furnace with less labor than torch or saw cutting. There are dozens of sizes of stationary and mobile shears available. Large shears have cutting rates measured in tens of feet per minute. The thickness, toughness, and dimensions of the metal to be sheared, the required cutting rate, and the product dimensions are important for selecting the proper kind of shears for the job.

Several kinds of electric power metal cutting saws are available, including those with circular and reciprocating blades. Saws can be used only on nonferrous metals.

Ship scrapping generates several grades and kinds of scrap metal, commonly called scrap species that are bought and sold in scrap materials markets. The scrap markets can be broadly classified as those dealing in ferrous scrap and nonferrous scrap.

Ferrous scrap from ships comes from forgings and castings, shell plating, framing, deck plating and beams, bulkheads, pillars and girders, miscellaneous hull steel, foundations, and steel superstructures. In addition, some structural steel outfit, hull attachments, doors and hatches, deck outfit, steward's outfit, hull engineering items, piping, and

miscellaneous machinery are ferrous scrap. Of these sources, the largest proportion is co-called "carbon steel," described in the scrap trade as No. 1 heavy melting scrap.

While there are many kinds of nonferrous scrap, one of particular interest is copper-yielding scrap (i.e., cuprous scrap). Cuprous scrap, which has a number of subspecies, includes bronze, brass, and various other copper alloys. While copper and copper alloys represent a small fraction of the total weight of the metals recovered from a ship, they return a large fraction of the revenue because of their high value.

## **4.2 Ship breaking process in Bangladesh**

In Bangladesh, the ship breaking process is almost the same as outline in the previous section. However, the process in Bangladesh has four distinct stages. These are:

**Offshore stage.** Offshore zone is the zone where the ship can move easily, i.e. up to the zone where the ship does not have to depend on the high tide to move. It normally starts 1 kilometer far from the beach. At this zone tanks are discharged and valuables (uncontaminated oil products, consumables and saleable such as electronic equipment) are removed.

**Inter-tidal zone.** Inter tidal zone is the zone where the vessel has to wait for high tide to beach in by own propulsion power. It stretches from the beach to around 1 kilometer. On low tide the vessels are lying stable on their flat bottom. Anyhow if it is necessary to bring the ship, it is done by winch. At this stage demolition is initiated.

**The beach:** Further cutting into manageable sizes, extraction of components and sorting for transport to respective receivers are carried out.

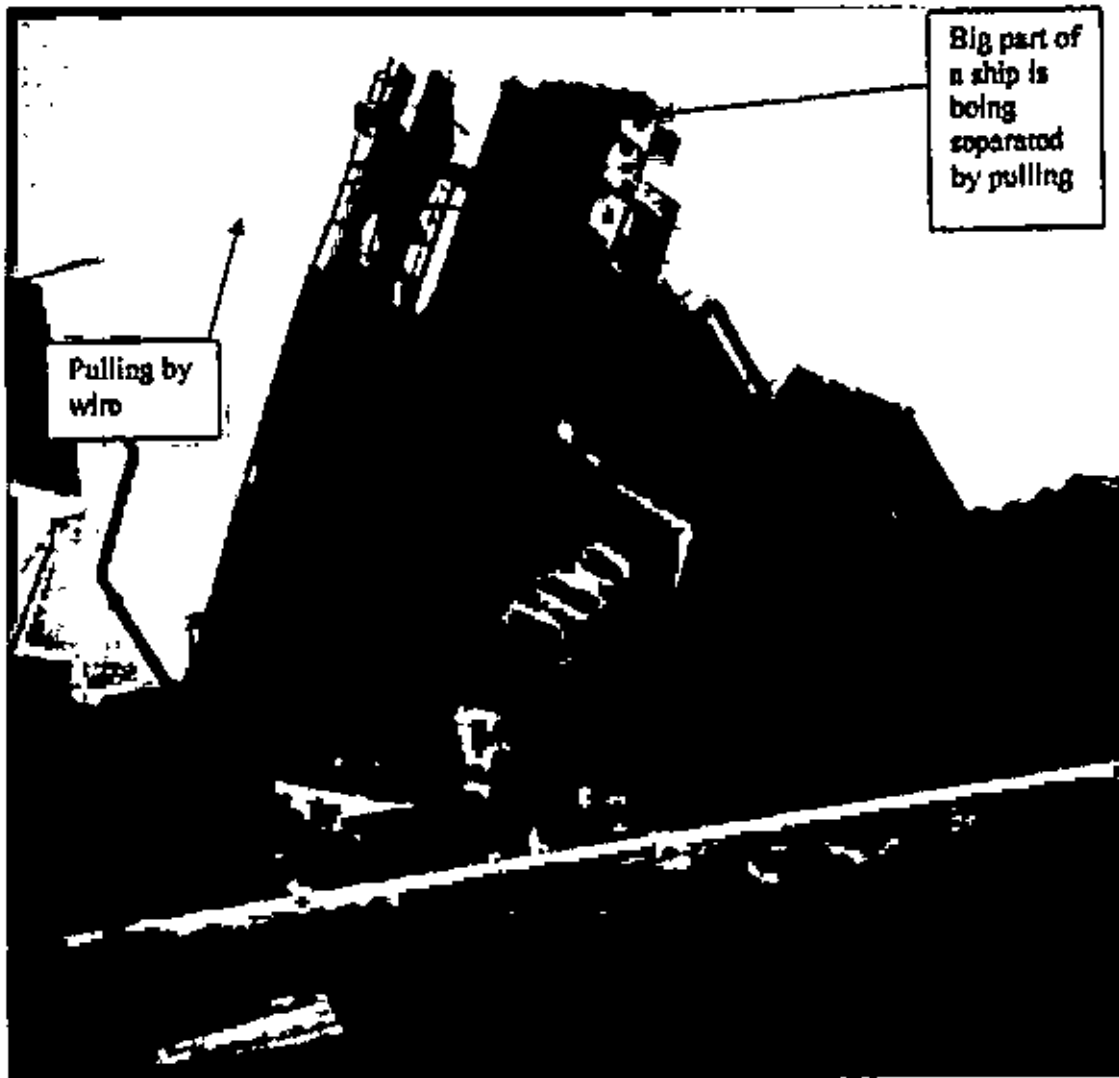


Figure: 4.1: Big part of a ship is being separated by pulling at beach

Shore: Supply of second-hand equipment and components to (local/regional) market and remanufacturing/recycling into new products/components (disposal and recycling).  
The above operations are further detailed in Table -4.1.

Table-4.1: The Detail operations at different stages of ship breaking with comments.

LOCATION	OPERATION	COMMENTS
Offshore	<ol style="list-style-type: none"> <li>1. Onboard consumables, saleable (loose) equipment are removed.</li> <li>2. Tanks emptied (in some cases, tankers and cargo tanks may be washed).</li> <li>3. Vessel is made as light as possible in order to enable it to "climb" as high as possible up on the beach (i.e. discharge is done at site).</li> </ol>	<p>These operations are carried out at or near the breaking facility. If reception facilities are not available, tank residues/ballast water, etc. is discharged to sea.</p>
Inter-tidal zone	<ol style="list-style-type: none"> <li>1. The vessel is beached by own power to gain access for structural demolition.</li> <li>2. The ship bow/stern and sides are opened to gain further access to components of value.</li> <li>3. Hull plating, larger sections and structural items are opened/ removed and sequentially extracted and winched/towed or floated ashore.</li> </ol>	<p>Antifouling, hydrocarbons in pipe works, void spaces, remains in tanks etc., and debris (heavy metals, paint remains, dust (asbestos, etc.) are deposited in the water/ground sediments/air. Emissions to air due to cutting.</p> <p>Torch cutting, material handling and associated work operations induce potential dangerous situations: burns, falls from heights, overloading by carrying, squeeze, falling objects, suffocation, explosions, exposure to toxins and/or harmful material, etc.</p>
The beach	<ol style="list-style-type: none"> <li>1. Size reduction of recovered scrap steel by torch cutting.</li> <li>2. Sorting of recovered materials (scrap steel, components, etc.) Transport/export of materials and substances.</li> </ol>	<p>Leaks from collected liquid storage to soil due to insufficient or lack of containment. Debris (heavy metals, paint remains, dust (asbestos, etc.)), residues from systems/tanks, etc. deposited into sediments. Emissions to air due to cutting and fires (removal of insulation, etc.).</p> <p>Ongoing cutting/sorting/transport operations causing potential dangerous situations: burns, falls from heights, overloading by carrying, squeeze, falling objects, suffocation, explosions, exposure to toxins and/or harmful material, etc.</p>
Shore	Sorted materials are transported to nearby markets or reprocessing facilities. (Disposal and recycling). Transport, overloading by carrying. Operations within the reprocessing sites. Indices of incidents related to the nature of the reprocessing activity (reheating – burns, etc.).	Hazardous materials exported from the breaking site (e.g. paint remains on scrap steel plating for cold-rolling/smelting, reuse of hazardous materials (asbestos containing substances (ACS))).



#### **4.2.1 Materials from ship breaking yard:**

Waste/material following demolition is distributed and transported from the scrapping site to local enterprises at the shore for resale, remanufacturing or recycling. Majority of the reprocessing enterprises are located in the vicinity of the scrapping facility.

The main materials and wastes available from ship breaking are:

##### **Ferrous scrap metal :**

Outfit and structural steel, hatch covers, pipes and pipe fittings, castings (stern frame), anchor and chains, propeller shaft, rudders, wires, sheet metals, tanks (non-integrated)

##### **Non-ferrous scrap metal :**

**Copper:** cables, pipes, motor windings, fittings, domestic pipe work, etc.

**Aluminium:** anodes, wheelhouse

**Zinc:** anodes

**Special bronze:** propellers, fittings

##### **Machinery:**

Main engine, auxiliary engines, pumps, generators, boilers, separators, steering gear, deck machinery, cranes, etc.

##### **Electrical and electronic equipment:**

Switchboards, consoles, control panels, navigational aids, domestic electrical items, instruments, sensors, etc.

##### **Minerals:**

Asbestos and mineral wool for insulation, ceramics (domestic sanitary equipment), concrete, tiles, glass, windows, etc.

##### **Plastics:**

Plastic pipe work, fittings, furniture, light fittings, lifeboats, rafts, etc.

**Liquids, chemicals and gases:**

Fuels, fuel oils, lubrication oils, hydraulic fluids, polluted waters, refrigerants, cargo residues, sludge, chemicals, etc.

**Joinery:**

Timber, joinery bulkhead and deck head panels, accommodation doors and frames, Furniture and furnishings, composite timber products, etc.

**Miscellaneous wastes:**

Domestic wastes, radiation sources (equipment, scale), mercury (i.e. in level switches, light fittings, thermometers), batteries, marine growth (fouling/ballast water and sediments)

Table 4.2 shows the main materials for specific part of the ship.

Table 4.2: Main materials for specific part of the ship

<b>Part of the Ship</b>	<b>Main Materials</b>
Hull	Mild steel
Super structure	Mild steel normally used, some times to lessen the weight of the ship, Aluminium, is used.
Propeller	Special bronze
Shaft	Brass
Chain	High grade mild steel
Anchor	High grade mild steel
Birth room fittings	Ceramics, concrete
Bed/Chair/Table/Locker, Furniture	Wood / plastic
Stair	Mild steel
Duck line/Kitchen fittings	Stainless Steel / Special bronze
Dash Board	Stainless Steel
Chathodic protection	Zinc
Rudder	Mild steel
Paneling Work	Wood
Pipe	Mild steel / plastic/ copper
Angle/T bar	Mild steel
Cable	Copper
Hatch Cover	Mild Steel

### 4.3. Value Chain of Ship Breaking:

The operations performed in the ship breaking process are performed at different stages as mentioned earlier. Some of the operations are regulatory in nature while others are physical operations to remove materials from the ship. Table 4.3 shows the operations in the whole value chain of the process.

Table 4.3: Value chain of ship breaking process

Stage of Operation	Sequence Operation	Done by	Materials
Offshore	1.Import Document Checking	Chittagong port Authority	No material found
	2.Inspection &Collection of Navigational equipments	Bangladesh Navy	Walki-Talkies, radios, wireless sets, etc
	3.Checking the safety measures (Pressure vessel, fuel tanks, water tanks, etc)	Mercantile Marine Department	No material found
	4. Cleaning	Ship Owners (Cleaners)	No material found
	5. Removal of loose materials	Ship Owners (labors)	Oil foods, medicine, & Other consumable items
Inter tidal zone	1. Scrapping the Stern aft of ship	Ship Owners (gas cutters, fitters)	Some steel Plate (M.S), Propeller (Bronze) rudder.

**Table 4.3 Continued**

Stage of Operation	Sequence Operation	Done by	Materials
<b>Inter tidal zone</b>	2.Opennig the hull platting	Ship Owners (gas cutters, fitters)	Steel Plate (M.S), Some structural items (M.S), etc.
	3.Extracting engine accessories, out fittings	Ship Owners (labors)	Engine, Boilers Pumps, Pipe Line (M.S/Copper) Light, Furniture Steering gear, Generator Cable (Copper), Life Boat, Raft, Electrical Equipment
<b>Beach</b>	1.Reducing the size of scrapped material	Ship Owners (gas cutters, fitters)	Steel plate sheet of various thickness, T-bar, L-bar (M.S) of Pipe (M.S/Copper), Plate (Aluminium), Others.
	2. Sorting	Ship Owner (Labors)	Steel plate sheet of various thickness, T-bar, L-bar (M.S) of various thickness, Pipe (M.S/Copper), Plate (Aluminium), Others.

**Table 4.3 Continued**

<b>Stage of Operation</b>	<b>Sequence Operation</b>	<b>Done by</b>	<b>Materials</b>
<b>Onshore</b>	1. Sorting by materials	Ship Owner (Labors)	No new material found
	2. Sorting by Elements	Ship Owner (Labors)	No new material found
	3. Sorting by Thickness	Ship Owner (Labors)	No new material found
	4. Loading the Carrier	Ship Owner (Labors)	No new material found

## **CHAPTER FIVE**

## Chapter-5

### SCRAPING & SORTING

#### 5.1 Offshore:

In this zone tanks are discharged and valuables (uncontaminated oil products, consumables and saleable such as electrical and electronic equipment) are removed. In this stage, removing siltation of oil residue and other liquid cleans the ship.

#### 5.2 Inter tidal zone:

The vessel is beached by own propulsion power at high tide. On low tide the vessels are lying stable on their flat bottom. The stern aft of the propeller is dismantled. The stern is divided into two parts along the centerline of the vessel. The two parts are dropped down into the sea and winched to the shore at high tide. The propeller is then removed.

Hull (side) plating is removed beneath normal waterline by the use of torch cutting equipment in order to gain access to engine room and adjacent areas. Different parts and machinery of the ship is then disassembled and taken ashore (e.g. pipelines, boilers, separators and pumps). Larger components, engines/generators, are further broken down in this zone. The items are dumped or lowered down through the hull openings. The items are then floated by use of air filled oil barrels or by boats on high tide.

The straight steel plates along the centre section are then dismantled. Outer hull plates are removed first followed by bulkhead structure. The outside plates are retained at the bottom in order to avoid water intrusion. The plates are dumped in the mud and then winched to shore.

The bow is cut free from the rest of the hull and winched to the shore. When the bow is removed, whole section of the ship is cut loose and winched ashore.

The main components dismantled at this stage are as follows: -

- i. Propeller
- ii. Pipelines
- iii. Boilers

- iv. Separators
- v. Pumps
- vi. Hull plates
- vii. Bulkheads
- viii. Bow

### **5.3 Beach**

The bow, steel plates and sections are cut into smaller pieces suitable for further transportation by lorry. Torch cutting, winches, manual pulling and crowbars are in use. Different pieces/materials are carried by from 1 to up to 30 people from the beach to temporary storage sites. At these temporary sites, materials are sorted in different piles. The materials are unified into the same “standard” sizes; cut if necessary, and stored in separate piles for plates with different thickness, pipes of different diameters, etc.

In order to achieve the highest prices, all equipment components are disassembled e.g. valves, flanges and gaskets are disassembled from the pipelines. In this stage, all of the items cut into the above section are again cut into smaller required size of pieces like valves, flanges and gaskets are dissembled from the pipeline. All materials that have been temporarily stored are then manually lifted onto lorries carrying the material to the next stage in the process.

### **5.4 Onshore – final destination**

After cutting into smaller pieces suitable for ultimate purpose, the materials are sorted by materials and then by elements and thickness. To get more profit the owner of the ship breaking industry do this. But they do not sort them scientifically. Generally the pile of sorted materials is kept near the entrance to ease for loading the truck and delivery. However, some irregular shape of metals is kept haphazardly in the yard. The wholesale businessman, steel mill owners and rolling mill owners come here and choose their required materials. The wholesale businessman takes their materials to their own shop yard; some are engaged to deliver them to the respective industry. There the materials, specially the materials that are auctioned are again sorted but not in scientifically. The owners of small shop of scrap materials who deal their business by only one or a few type of materials collect their materials from wholesale businessman.



They again scrap the brought materials into specialized item or metal and make ready for sale. Figure 5.1 shows the sorting system of the materials scrapped from old ship.

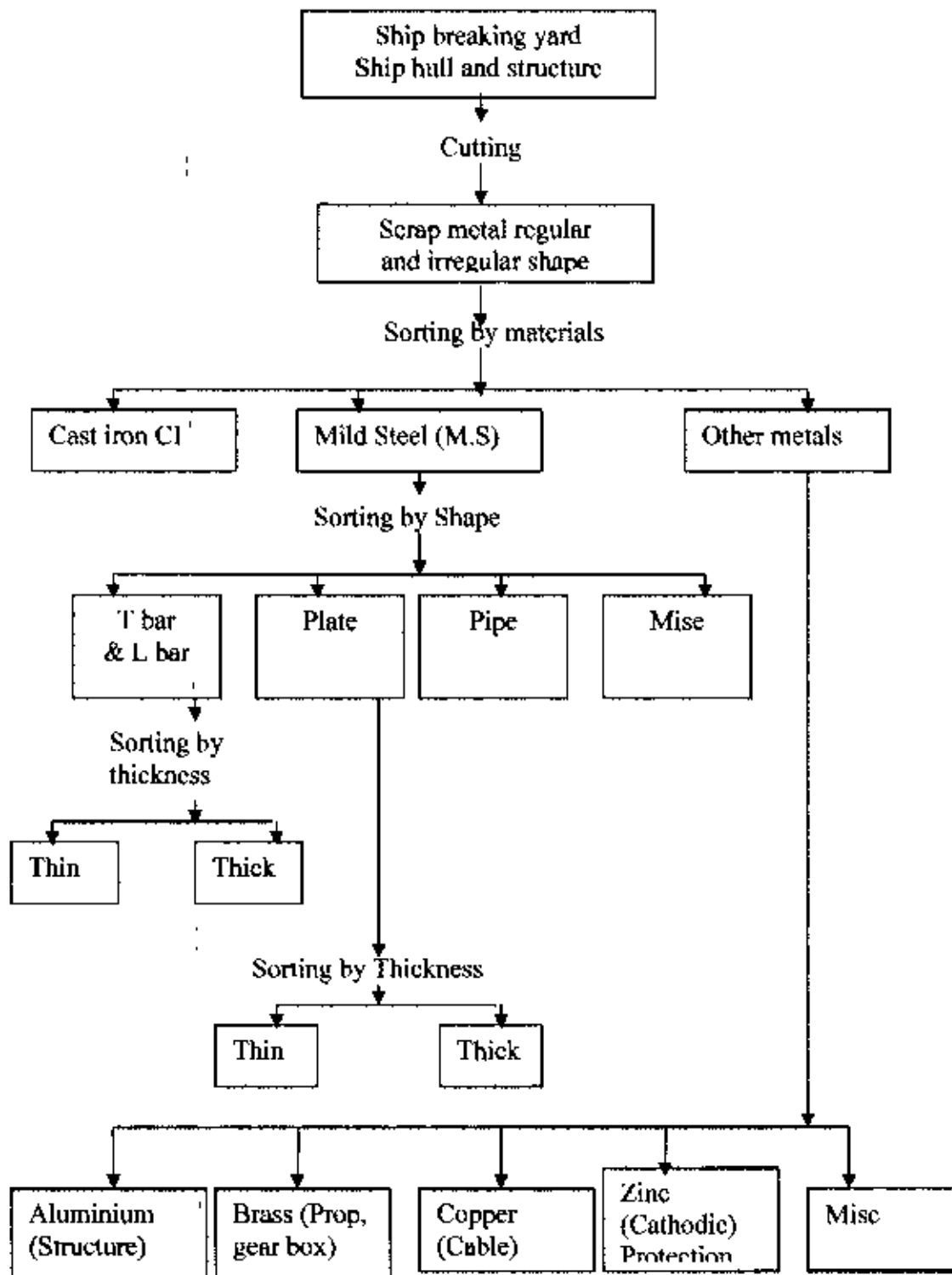


Figure 5.1: Sorting system of materials scrapped from old ship

Piled up in different places and these are kept ready for sells. The wholesale customer come to the yard observe the pile of materials and select for buying.

## **CHAPTER SIX**

## Chapter-6

### SHIP SCRAP MATERIAL MARKET

As the ship breaking industry is the main source of metal, ship scrap material market was established near the ship-breaking yard along the two sides of Dhaka-Chittagong high way. The zone is village like. The length of the market is about 10-12 km and the width of the market is about 1 km. The density of scrap materials market is not like other market. The average distance of the one business organization to the other business organization is about 100 m. The market is very calm and quite. Most of the Shops (95%) are in open yard with boundary less. For safety and office there is a small house at the one corner of the shop yard. About 10% shops have a named boundary. Every yard there is some old items, which were brought a several years ago. They become rusty. But the shop owner donot have headache about that. Most of the shop-yards are at a lower level of the highway at low land areas. As a result of heavy rainfall or flood, the yard goes under water. As the shops are very near to the high way it is very easy for them to transport items countrywide.

#### **Activities:**

In every shop yard around 5 or 6 persons are always working there. The activity depends on the type of items. In cable shops the labors have to dismantle the copper ware. In the shop where engine are scraped they have to break the engine and sort the items as product like bearing, steel ball, nut, bolt etc. In cast iron shop heavy big size cast iron are broken according to their required shape. Similarly, in light shops, some items are sorted as a good condition and remaining are repaired etc. With the activities, some people are engaged to sell the items to the customer. They sort items from aesthetic view.

## **6.1 Market Players**

Among market players of ship scrap material market ship breaking yard owners, whole sellers, steel mills owners and rolling mills owners and owners of light of light engineering are important.

### **Yard owners:**

The owners of yard always want to get profit more, as a result they want to scrap the vessel as quickly as possible consequently, they have to engage more labors. Except that, the owners have to give extra pressure on the to labors. Not only that they always sort primarily by the materials and then by the geometric features. Around 70% yard owners sell their scrapped materials from their own scrap yard. They normally supply the material to the market by whole sellers. The remaining 30% yard owners have their rolling mills or steel mills. They don't sell their scrapped materials. All of the materials are supplied to their own rolling mills.

### **Whole Sale Businessman:**

Wholesale businessman take part an important roll to the scrap material market. Before scrapping the ship, all of the machinery items fittings, accessories and ornament like item ure auctioned. Wholesale businessmen are the main customers of ship breaking yard. Because the auctioned amount varies from 30, 00,000 to 80, 00,000 and it depends on the size type and aristocracy of the ship. The small businessmen buy their respective materials from the whole sellers.

### **Rolling Mills:**

Most of the rolling mills are established in the vicinity of ship breaking yard. Normally they buy regular shape of plate. For the raw materials of rolling mills, they have to depend on 90% on the ship breaking. For irregular shape of materials they get scrap. again. They sell it to the steel mills. So they take part as sellers as well as buyers

### **Steel Mills:**

Steel Mills depend on the ship-breaking yard for 90% of their raw materials. They buy regular shape or irregular shape of metal. For irregular shape of mild steel, they melt them and maintain the composition they mix other materials and produce

ingot materials, which can be used for further reprocessing for building materials or others.

### **Light Engineering**

Light Engineering covers small and medium scale metal industries. In the light engineering field normally specific grade of metal is required as they manufacture products for specific purposes. Unfortunately these light engineering workshops do not have the scientific knowledge and facility to collect the right quality & composition of the materials. To buy the required materials they normally go to the scrap market and chose the materials through visual inspection and assessment. Sometimes floating broker in the scrap-yard also helps the LE workshops to locate and collect materials.

## **6.2 Materials market:**

### **6.2.1 Materials and Sellers**

Non-metallic materials like furniture and bathroom fittings and engine accessories & others that can be loosed are auctioned before scrapping the ship. The scrap yard owner is the prime seller. All type of selling and buying starts from scrap yard owner. The wholesale businessmen help the scrap yard owner by buying the auctioned materials. The owners of the small shops of materials are the secondary sellers of materials. They take the item or materials from wholesalers. The secondary sellers again help to sort the materials for specialization. To make more profit, sellers at all levels sort the materials for further specialization. Figure 6.1 shows the relation of sellers, buyers and respective materials.

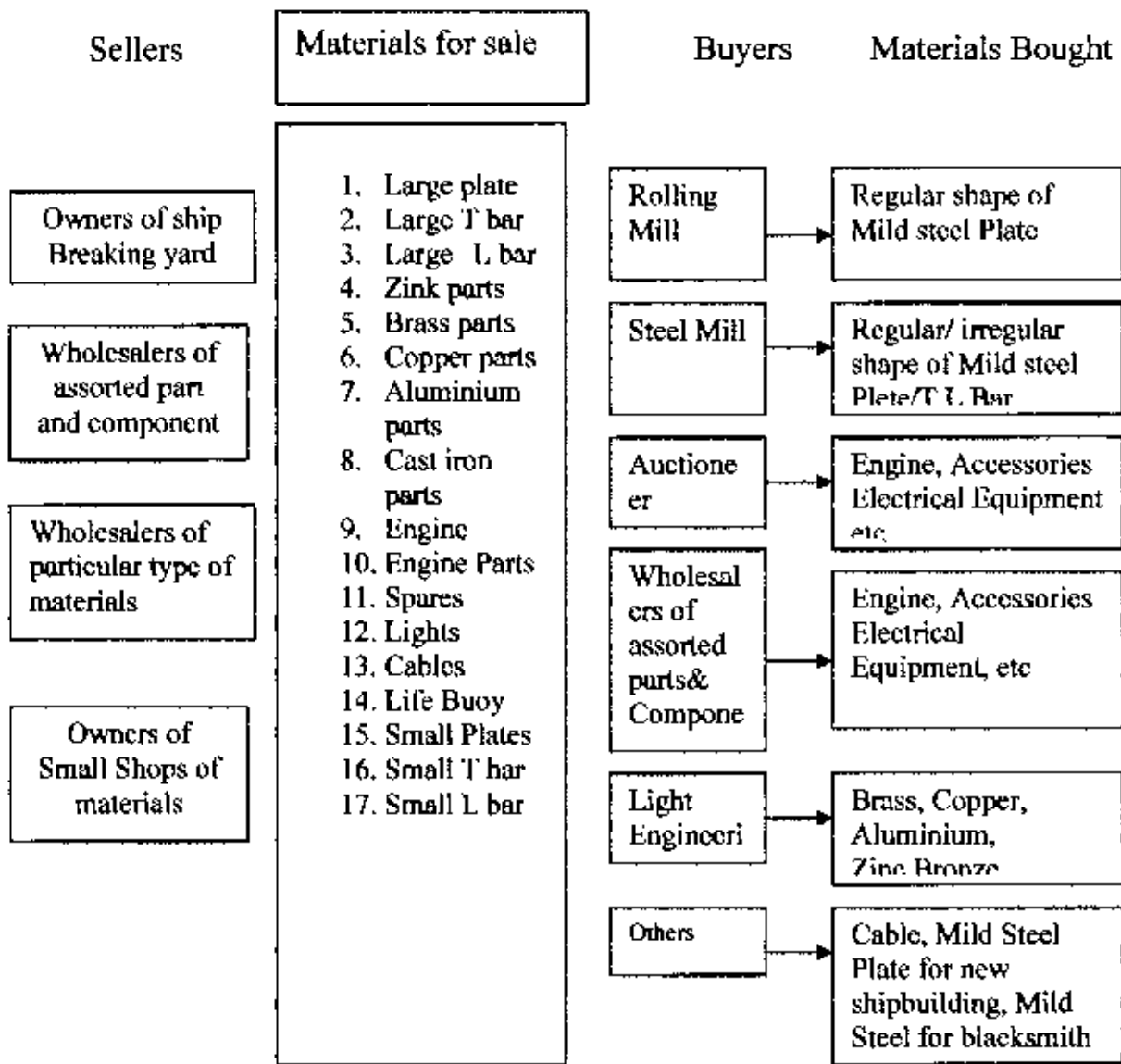


Figure: 6.1 Relation among sellers, buyers and respective materials.

### 6.2.2 Materials and customers

Light Engineering, steel mills, rolling mills, cable industries, cast iron tube well industry, new ship building are the main destination of the metallic materials scrapped from ship. Owners of new house building are also the customer for bathroom fittings light and other housing furnishing elements.

All light engineering are not directly engaged to the scrap materials market. Normally floating broker of individual item moves to the market and collect their respective materials. When they can pile their required amount they supply it to the

respective light engineering organization. The steel mills buy their raw materials (T-bar, Angle bar, Plate) from the scrap yard. They also buy the scrap materials (pieces of irregular scrap metal) from the scrap yard. The scraped metals are melted in their industry. Now and then they collect the scrap materials from rolling mills. Rolling mills collect their raw materials from ship breaking yard directly. They normally choose the regular shape. Apart from the above customers, there are other customers who look for specific type of materials or components. They can be categorized as below:

#### **Workshops Using Brass**

1. Ornaments Shops.
2. Lock and Keys workshops.
3. Sticker Name plate, medal of gift workshop.
4. Belt, watch, chain workshop.
5. Flower stand Pot.

#### **Workshops Using Zinc**

- 1 Galvanizing.
2. Cell.
3. Sanitary fittings.
4. Tin industry.

#### **Hardware Workshops**

- 1 Pot of aluminium.
2. Machinery parts.
3. Frame for glass as building materials.
4. Birth room fittings.
5. Door or windows.
6. Electrical instrument.

### **Workshops Using Cast Iron**

- 1 Machinery parts.
2. Railway industry.
3. Tube Oil.
4. Cooking Pot.

### **Workshops Using Copper**

- 1 Motor (Electrical)
2. Cable industry

### **6.2.3 Problem and opportunities in material market:**

#### **A formal market developed:**

For the scrapping of old ship, a formal materials market has been established. It is the only metallic material market in Bangladesh. Ship breaking yard is the main source of metal. All of the metals are distributed through materials market. Various types of metal and materials are available there. People from all corner of the country come here to collect their required metal. The customers can compare the quality and price of metal.

#### **Transportation**

As the scrap material market has been established besides the Dhaka Chittagong high way along 10 to 12 kilometer near the Chittagong main city, it is very easy to move from one shop to another shop conveniently. The carrier can also move from one shop to another shop. Once purchased the transport for the material is easily available both for small amount or large amount.

#### **Employment**

In around one thousand shops about 5 to 6 thousand people are engaged there directly. This market is directly related to other metal sector industries as well as light engineering workshops scattered all over the country. So, indirectly this market is a lifeline for many people engaged in those linked industries.

#### **Safety**

In the small shop yard, the labors do not follow the safety protection. Most of the activities are done manually. The major work is material movement. The workers



often do this work without the help of any mechanical loaders/unloaders. They donot use boot, goggles, aprons etc.

### **Environment**

The scrap material market is at low land area beside the high way. As a result the land is flooded over during heavy rainfall or a heavy high tide. The soil became irony and black. This results the loss of fertility of land around this market. The air is polluted by the noxious gases produced in various empty space of various type of item that are kept in the yard of small shop for a long time.

### **Material Information:**

It is the only one formal material market in Bangladesh. Many traders who deal the materials especially metallic material know about this and many of them do not. Therefore, most of the owners and the employees who engaged there do not know how much availability of a material is there and which material is found in which shop. It results in the difficulties to the traders from different parts of Bangladesh who want to buy a specific material from that market because they have less chance to get information from a shop. If the traders want to buy specific materials from that market they have to go there and search for that material one after another shop. It is quite difficult, costly and time-consuming matter.

### **Material Categorization:**

Hull (M.S) and superstructure (M.S/Aluminium) parts of ship are separated at the ship-breaking yard. Here, generally engine, boiler, generator, pumps, light, electrical equipments, some pipe, ladder etc are brought. However, wholesalers also bring some specific non-steel metal here. Some items are sold directly according to their condition. The remaining items are dismantled. Various types of materials and parts are found. As the employees who engaged there to these jobs have no scientific knowledge about metal. They sort them by visual inspection.

#### **6.2.4. Suggested Improvement in Materials Marketing:**

##### **1. Information Centre:**

An information centre can be set up. The function of the centre may be to collect to the shop name, location, available items found, corresponding price, etc. If this can be done, a trader from any remote area can collect his required information over telephone or mobile phone with a little expense. Any third party can do this.

##### **2. Buying Agent:**

A reliable buying agent can be established at the market. If this can be done, a trader from any remote area can demand his respective materials to the buying agent and the buying agent can arrange all according to the terms and condition. It reduces the cost price of raw materials and time taken

##### **3. Sorting System and Expert:**

For better marketing, the properties of each material item can be identified through appropriate testing. The wholesalers or any third party may come up with this kind of service.

## **CHAPTER SEVEN**

## Chapter-7

### DEVELOPMENT OF SHIP BREAKING BEST PRACTICE

The lifetime of a vessel is about 20 years. Whenever any conversion or modification might have been carried out, the lifetime cannot be extended beyond 25 years. The International organization has fixed 25 years as lifetime for a vessel. A new ship is built from fresh or near by fresh materials by a systematic way following a chain of steps, which consist of various jobs and operations. While building a new ship, at each step different types of operations are going on. But these are done at different places at the yard with different team, which consists of 3 or 4 members. After 25 years, when a ship is declared as an old ship, it is sold for scrapping. Scrapping of a ship can be thought, as the reverse process of ship building .The purpose of scrapping the ship is to rescue the materials properly with a minimum amount of expenditure. In ship breaking industry, the owners of breaking yards, do not perform the technical operations systematically. They rescue the scrapped materials haphazardly without planning. This results in a great number of unexpected incidents

#### **7.1 Better Layout:**

Like the shipyard or dockyard, the ship-breaking yard can have an infrastructure to rescue all the materials properly. Pulling the ship from inter tidal zone by winch is very much risky. This system can be replaced by setting the launching system at the yard. For small breaking yard one launching system and for big breaking yard two or more launching system can be set up. By using launching system, the whole ship can be brought at the beach from inter tidal zone without dismounting the heavy and sophisticated items like engine, furniture, accessories, etc. Figure 7.1 shows the existing layout of an existing yard and figure 7.2 shows a more organized layout, which is conceived as the reverse process of shipbuilding.

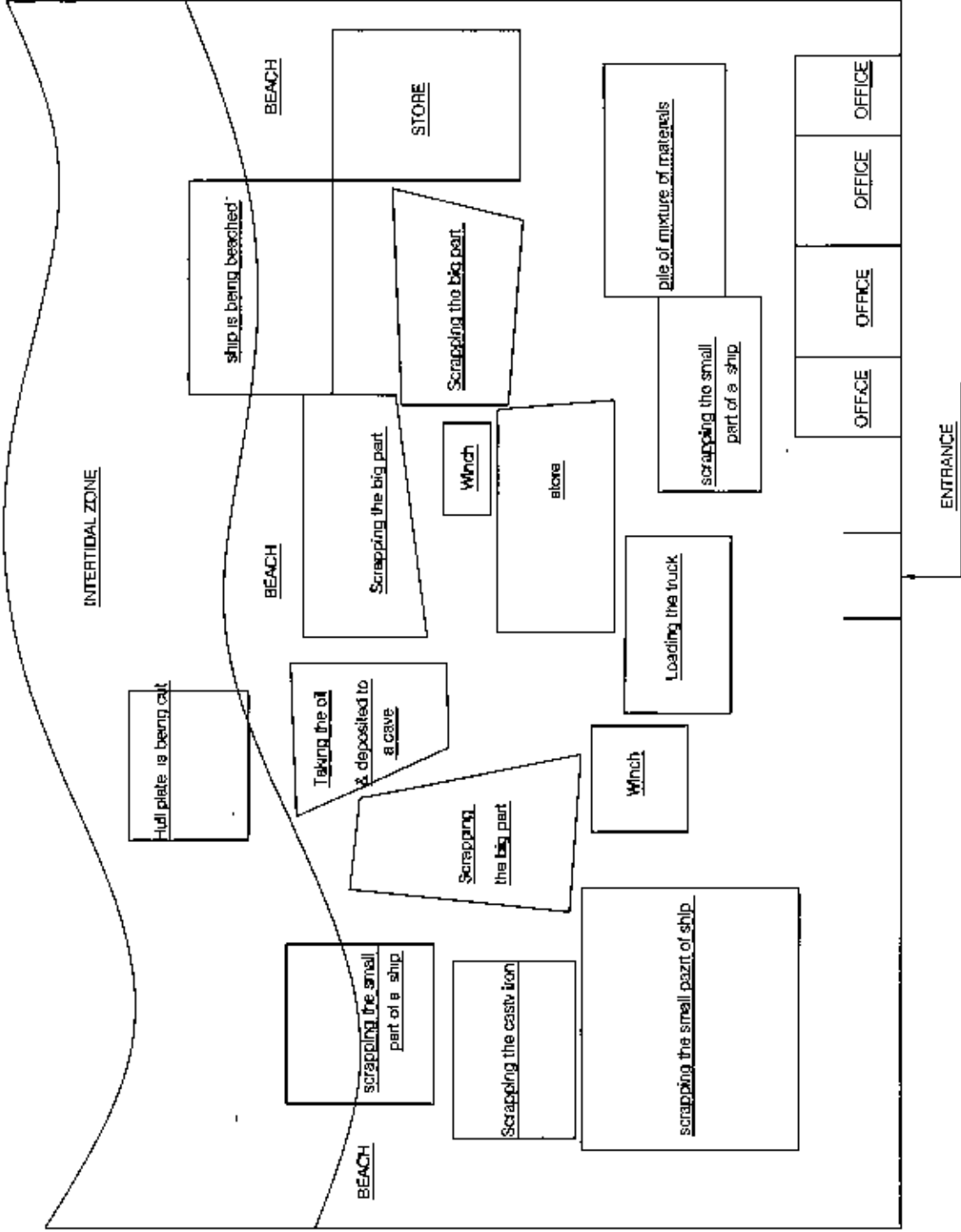


FIGURE 7.1: LAYOUT OF A TYPICAL EXISTING SHIP BREAKING YARD

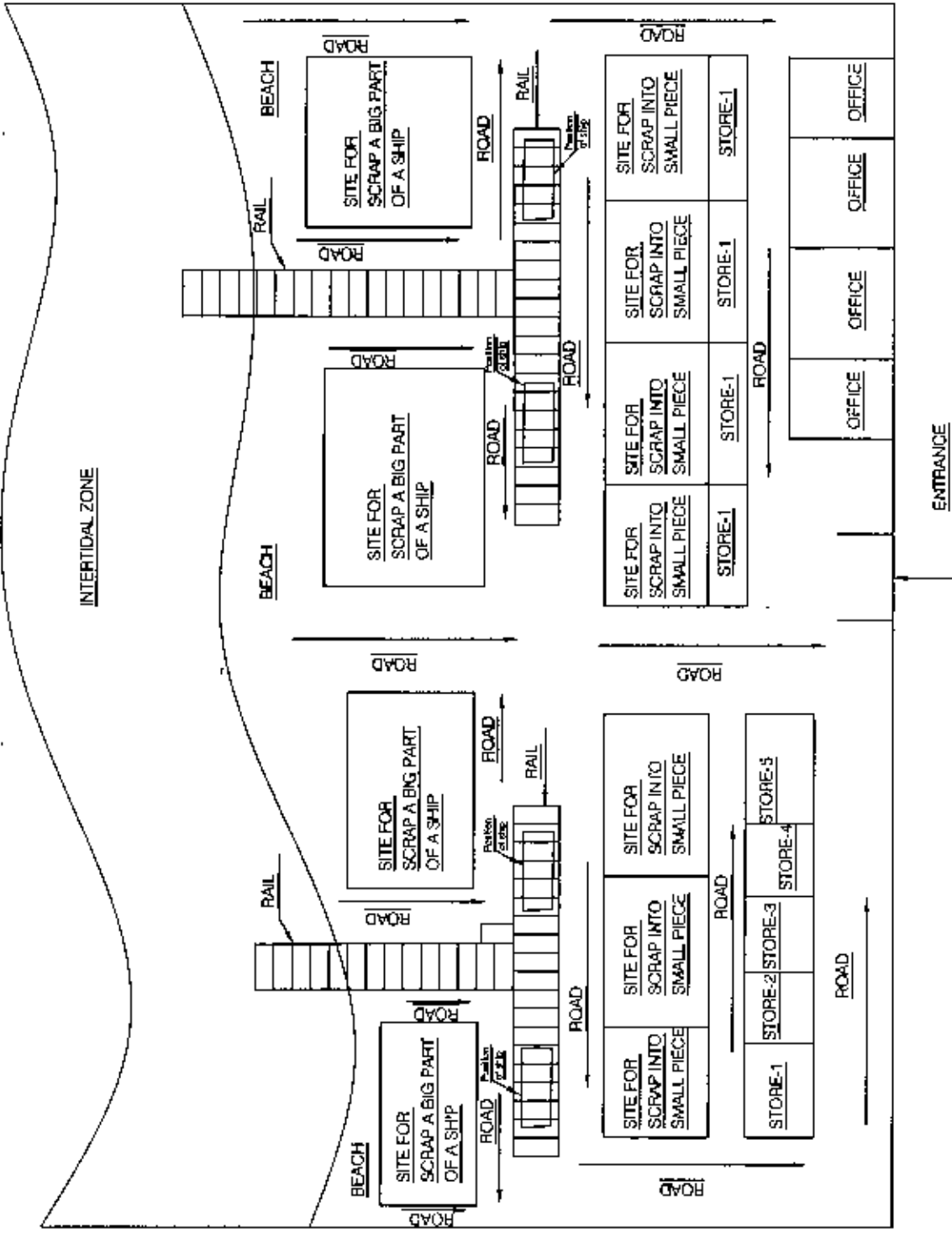


FIGURE 7.2: LAYOUT OF A TYPICAL MORE ORGANIZED SHIP BREAKING YARD

## 7.2. Operation Sequence:

Operation sequence of shipbuilding is as follows

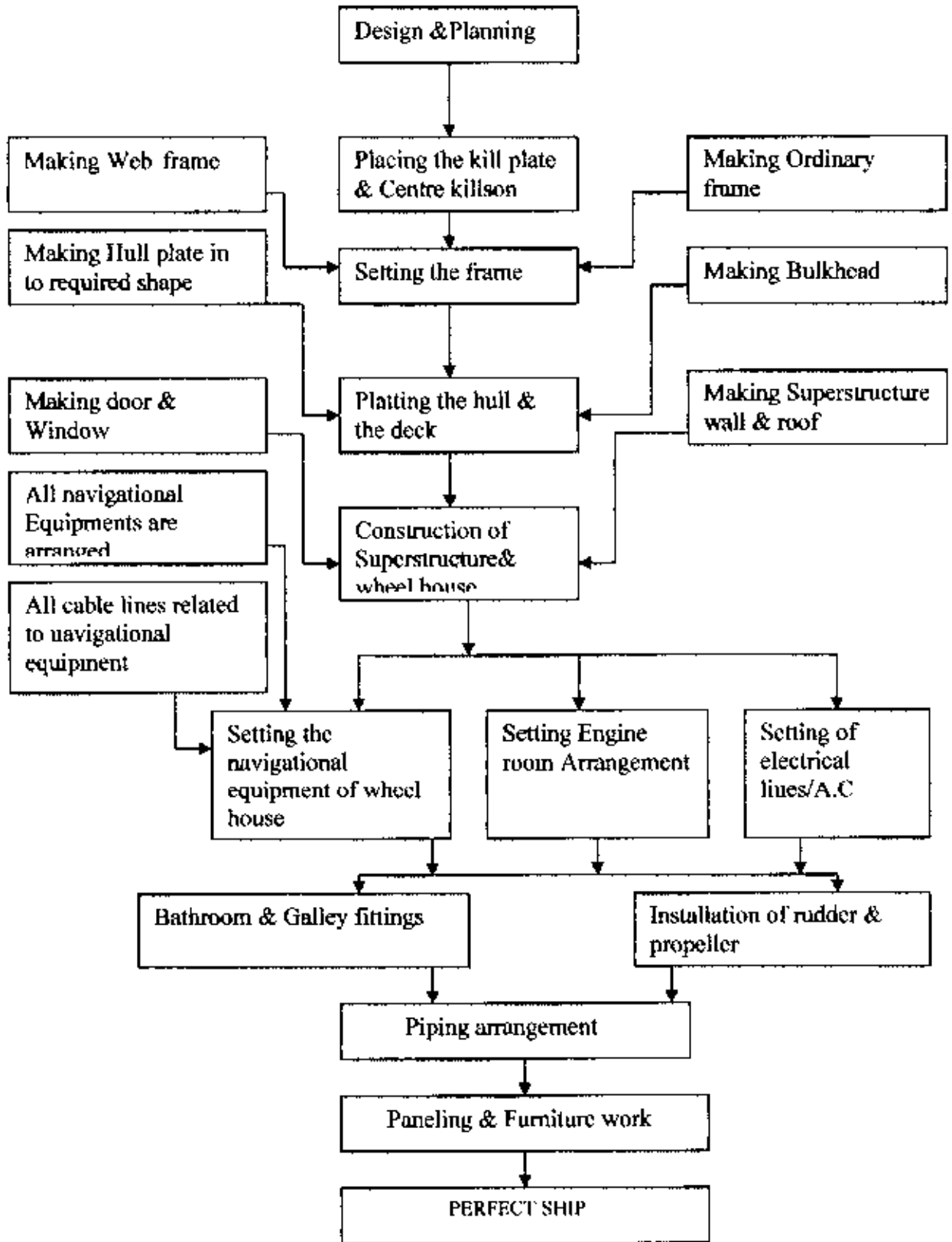


Figure 7.3 Operation sequence of shipbuilding.

Operation sequence of ship scrapping which can be thought as the reverse of shipbuilding could be as follows:

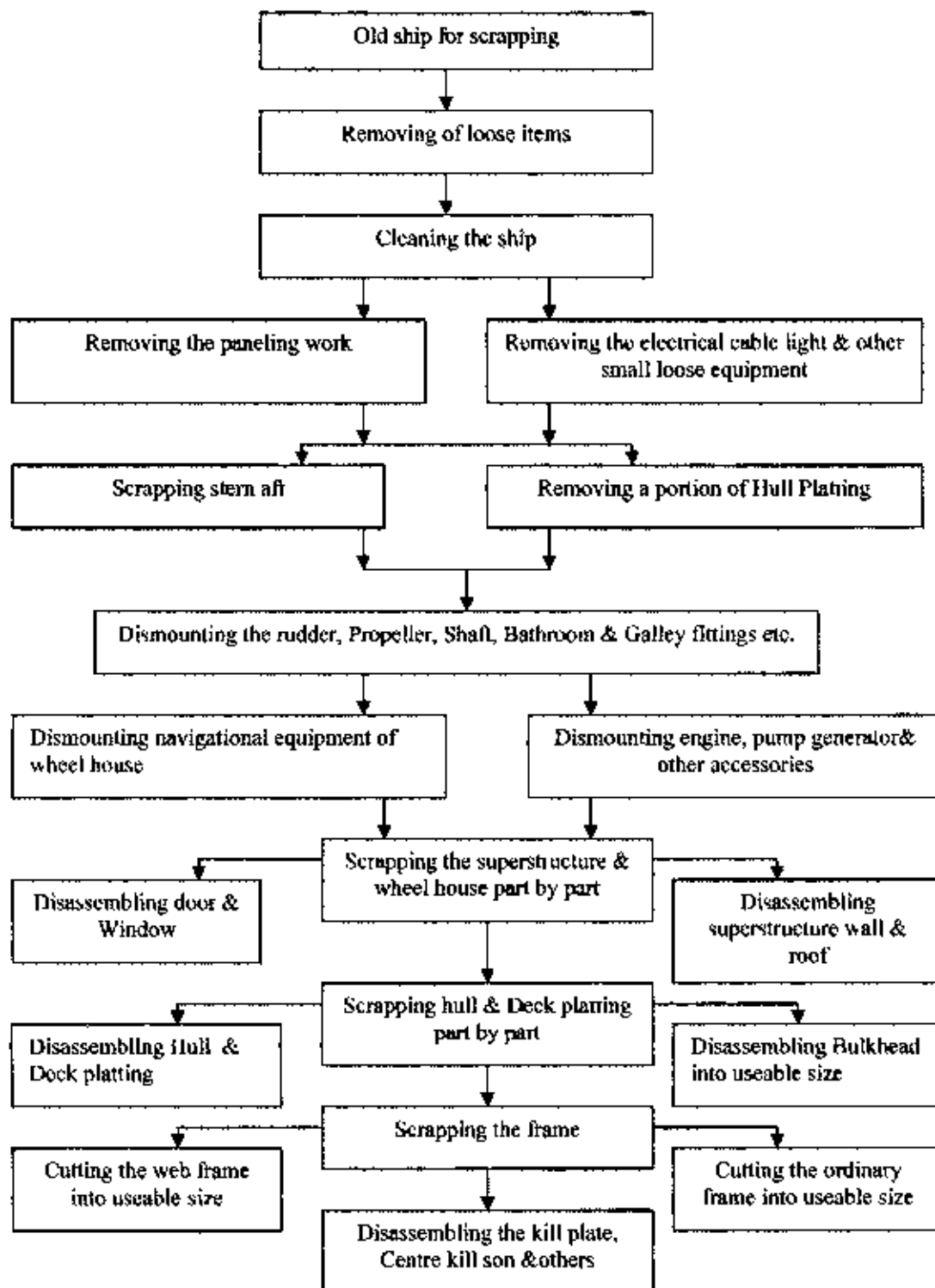


Figure 7.4: Operation of ship scrapping.



### **7.3 Material Sorting:**

Later the scrapped useable materials can be sorted according to by materials and by element sand thickness. If this can be done, the jobs can be specialized at different places. As a result the teams or labors are engaged at a specialized job at different places at the yard. It can reduces the randomly movement of labors as well as crisscross operation that results the less probability of unexpected incidents. In the stage of sorting the materials, the ranterials can be sorted considering all aspects especially scientific knowledge. Composition of materials and physical properties of the materials can be considered with the use of spectrometer and other testing equipment.

## **CHAPTER EIGHT**

## Chapter-8

# DISCUSSION & CONCLUSION

### 8.1 Discussion:

Ship breaking industry is one of the important sectors of industry that contribute in the development of the country. About 5.63% of industries are directly or indirectly connected to this industry. Those industries have to depend on the ship breaking industry for their raw materials. It has a great importance on the employment. In this industry and the industries connected to this, about 3.803% of total national employments are directly or indirectly engaged indicating an important role of the sector.

Any disruption of ship breaking industry changes the scenery of the materials market especially for building materials. The scenario of market price of a product related to this industry is also affected. With this, the employment opportunity and gross income are also affected significantly.

#### 8.1.1 Administrative aspects of ship scrapping:

Informally many government and non-government organizations are involved in this industry. But there is no formal government organization that takes care of the industry. Actually it is a floating industry. As a result, the breakers scrap the ship according to their own wish. While scrapping the ship, many governmental organization or non-governmental organization interfere to this with very marginal interest and behaves with very little responsibility. As a result of no care or little care of the government, the breakers do not take care about the environment safety and health and basic rules and regulations of the country. They want to get profit more and try to finish scrapping the ship as far as possible. Therefore they do not want to follow the protocol and the procedure for the safety. This results a significant number of casualties.

### **8.1.2 Ship Breaking Process and infrastructure:**

The ship breaking process is the reverse of ship construction. The decommissioning of ships for scrapping and disposal/recycling consists of a string of subsequent actions that can be grouped into rough categories all of which represent elements of potential threat in relation to safety, health and the environment. In ship breaking yard, ship is scrapped without any planning, systematic and better technical way. In spite of having the named certificate from the explosive department the toxic gas explosion often takes place. Most of the activities are done manually. Often more than one activity is performed simultaneously in overlapping zone. This unplanned activity is a major cause of mishaps and usually results in severe loss by accident. The infrastructure of the yard is not well planned. As a result, it is very difficult for a labor to work there properly

### **8.1.3 Materials aspects of ship breaking industry:**

The main purpose of ship scrapping is to collect the materials. At first, the auctioned materials are sorted and it is done by wholesale businessmen. The sorted materials are mainly furniture, engine, light, sophisticate navigational instrument etc. In the fourth stage of ship breaking process, "onshore stage" after cutting the materials into useable size for the final destination, primarily the materials are sorted by materials, for example, mild steel, stainless steel, cast iron, brass, zinc, copper, aluminium, etc. After this the materials are again sorted by elements, for example, plate, T – bar, angle bar, Pipe, etc. And later they are sorted by thickness. All of the sorting is done by visual inspection. Physical properties and chemical composition are not considered here. As a result, perfect materials designed for perfect product are not found from this sorting. This is also true for small scrap materials shop yard. Here, heavy engine, complex type items, and other auctioned items are scrapped and sorted.

The LE workshop owners or their brokers move from shop to shop to collect their materials for their specific purpose. They have some idea of the material they are looking for but do not know how to spot them. There is facility to check the physical and chemical properties of the metal in the scrap market.

**8.1.4 Material Market:** All scrap material shops are scattered at about 10 square kilometer besides the Dhaka-Chittagong high way. It is difficult for a typical customer to easily spot a material in the market. If a trader from any corner of Bangladesh wants to buy an item of material or collect information about that material, he has to go there and move door to door to find the material. It is costly and time-consuming matter.

## **8.2 Conclusion:**

As the ship breaking industry is connected to many of the parts of the development in Bangladesh, it should not be neglected. The development of this sector can develop the gross national income, employment and worthiness of materials by using proper materials for the properly designed product.

To develop the sector, government should include this industry under the ministry of industry and formulate a policy so that worker's rights could be ensured and it could be eco-friendly. Environment, human rights and economy, these three things should be considered in formulating the public policy for this industry.

Before scrapping the ship the explosive department should investigate the ship properly. And after making the ship gas free (in true sense) it should be beached to be scrapped. The infrastructure of ship breaking yard should be like dockyard and like the typical plan shown in the previous chapter. The ship breaking activities should be operated in a planned and hygienic way. An operational plan could be designed before starting to break the ship. A safe working rule/procedure should be adopted for the ship breaking industry.

Materials should be sorted wisely and technically so that it can be used efficiently. It can reduce the wastage of metal by using for the wrong purpose. To do that, spectrometer and material testing machine could be set up at the ship-breaking yard and in the vicinity of the ship-breaking yard where the vendors dismantle the machine. As a result the end users can choose the proper materials for their industries and machine shops. It will help to improve the quality of the product.

An information center and a buying agent can be set up at the scrap material market. It will help to collect information as well as collect materials from a remote area. It reduces the cost price of raw materials. All the above services can be provided by a third party on a commercial basis.

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## Some Questionnaires

### Procurement Process

1. What are the criteria used to determine the price of an old ship?  
 Light weight     Age                     Others
2. What is the buying price per ton (light weight) of a ship?  
 25000-28000Tk    28000-30000Tk    30000-32000Tk    32000-40000Tk
3. What size of ship do you buy?  
 Large                     Medium                     Small
4. What type of ship do you buy?  
 Inland ship         Ocean going ship
5. Where do you buy from?  
 Local Market    Abroad
6. How a ship is brought to the coast?  
 by towing             by driving itself    Others
7. Is there any inspection when the ship reaches at the coasts?  
 Yes                     No
8. Is it mandatory to inspect the ship?  
 Yes                     No
9. Who inspect the ship?  
 Navy    Coast Guard    Customs    Police    income tax office
10. Who pays for the inspection?  
 Owner    seller    Govt.    No payment    Others
11. What do they check?  
 Rejected items by the seller    Arsenal    illegal items
12. After inspection, how is the ship brought to the yard?  
\* \* After inspection, the ship is brought from coast guard to near to the yard by driving by our indigenous marine engineers. Then, at the period of high tide, the ship is further brought very near to the yard. Later it is towed by strong winch and make it ready for dismounting and scrap.



### Scrapping Process

13. Do you clean the ship before starting the work?  
 Yes                       No
14. Do you test the tank, container etc to check the poisonous gas by specialist before starting the work?  
 Yes                       No
15. Do you aerate the closed spaces before cutting operation?  
 Yes                       No
16. How long does it take to scrap a ship?  
\*\* Actually it depends on the light weight of the ship and the no of labors engaged. To do that the owner engaged such a no of labors so that it can be scrapped with in 2-3 months.
17. Which operation do you take first as a consideration?  
 Dismounting the machinery & furniture  
 Scraping the Hull or deck
18. Who is responsible to dismount them?  
 Owner                       customer                       Others
19. After dismounting of electrical instrument, mechanical parts and machinery, which part of the ship is considered to scrap first?  
 Hull                       Deck                       Others
20. Do you sort the scraped materials?  
 Yes                       No
21. What are the criteria used to sort the scraped material? ‘  
 Type of metal     Size of materials  
 condition of materials                       Others
22. For the case of Ferrous material do any secondary sorting?  
 Yes                       No

23. What are the criteria used to sort the Materials?
- Thickness       Shape       Weight
- Condition       Others
24. Do you sort steel material according to steel grade?
- Yes       No
25. Do you get any liquid from ship?
- Yes       No
26. Which type of liquid, do you get?
- Fuel       Poisonous chemicals (oil residuc)
- Others
27. What do with the poisonous chemicals (oil residuc)
- Used in industry       Kept in remote area
- Throw it in the sea       Used for other functions.
28. Are the poisonous chemicals (oil residue) responsible to pollute environment?
- Yes       No
29. Which part of environment does it pollute?
- Air       Soil       Water
30. How are the sorted materials sold to the market?
- Auction       Advertising       From yard to local brokers
- From yard to local customers       Others
31. Are al the items of ship sold at the same price?
- Yes       No
32. What are the criteria used to determine the selling price per ton of materials?
- Types of materials       Thickness of materials
- Shape of materials       Others       Condition
33. Where is the destination of each part?
- local Market       various industry, mills & factory       abroad

## Organizational

34. Normally how many teams are in a ship breaking yard?  
 8—10       6—8       10—12       12—14
35. How many members are in a team?  
 3—4       4—5       5—6       7—8
36. What is the status of recruited labors?  
 daily basis       permanent basis with a fixed scale  
 condition basis       others
37. How much labors are paid?  
 10—12 tk./hr       12—15 Tk./hr.  
 15—20 Tk./hr
38. How long do they have to work in a day?  
 8 hr.       10 hr.       12 hr.       No definite hour
39. What items do you provide labors for safety?  
 helmet       gloves       boots       goggles       others
40. Do you tell labors about the importance of putting on them (item)  
 Yes       No
41. Do you pursue labors to put on them (item)  
 Yes       No
42. How much do you insist on them to put on them (item)  
 strongly       normally       not persistent
43. Do you provide facilities of health and medicine?  
 Yes       No

## Labors

44. Does the owner provide helmet, gloves, hool, goggles etc.?  
 Yes       No

45. If provided, do you use helmet, gloves, boots, goggles?

\* \* They do not care for safety, i.e. they don't know the importance of using the safety items. They feel uncomfortable while they are putting on safety items due to lack of nutrition.

46. If no, Why?

Uncomfortable     Not aware of danger     supplier does not insist

47. If any accident occurs, what type of help, the owner provide?

- just primary treatment
- full treatment cost
- all compensation for the family
- A negligible compensation
- Financial help

48. What type of facility, does the owner provide you?

- Health and medicine     Shelter
- Food                       Cloths
- Others

### **Rolling Mills**

49. Which materials from ship breaking industry do you use as a raw materials for your mills?

- Hull                       structure                       Power plant.

50. Do you get any scrap when you make the materials.

- Yes                       No

51. What do you do with the scrap materials?

- use to own mill
- Supply to the industry where scrap is melted
- others

52. What is the selling price of the scrap materials! ton?  
 15000-16000 Tk.  16000-17000 Tk.  17000-18000 Tk.
53. Do you control the composition of product?  
 Yes  No
54. Do you control the temperature while heating the proceed materials?  
 Yes  No
55. Is Chittagong ship breaking industry enough for your raw materials?  
 Yes  No
56. What are the raw materials of in got product?  
 Scrap Materials from ship breaking industries  
 Scrap Materials from ship breaking industries  
 Scrap materials from re-rolling mill  
 Others
57. Is ship breaking industry enough for your raw materials?  
 Yes  No
59. How do you control the composition?

\* \* At any moment sample is taken from the furnace, make is cool and polish to ready for the test. Then it is kept at the bench of spectrometer. From spectrometer we can know the composition of the object. Now if it is necessary to change the composition, calculated amount of decided item is added to furnace. And again test it. After doing this again a requires composition is found.

### **Material Merchants**

60. What type of end-users are in Bangladesh?  
 Light engineering  casting  
 cable factory  other

61. Which materials do you deal as raw materials?
- Fe,  Pb,  
 Al,  Zn,  
 Cu,  Brass,  
 Specified materials
62. Where do you buy it from?
- Chittagong ship breaking yard  Importer  
 Other
63. Can you satisfy all your customers materials equipments?
- Yes  No

**Light Engineering workshop**

64. Where from do you procure raw materials
- material merchants  Chittagong ship breaking yard  
 other
65. Do you get all kinds of materials that you need from your sources
- Yes  No
66. If no, what kind of materials?
- Alloy steel  specific grade of steel  
 Stainless steel  Aluminium  
 Tool steel

