REPUBLIC OF TÜRKİYE
MINISTRY OF INDUSTRY
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İZMİR
DEVELOPMENT
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İZMİR ALİAĞA SHIP RECYCLING SECTOR ANALYSIS

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Megapol Çarşı Kule, Halkapınar Mahallesi,
1203/11. Sk. No: 5-7, Kat: 19
35170 Konak/İzmir
Tel : 0232 489 81 81
Faks : 0232 489 85 05
E-posta : info@izka.org.tr

Grafik Tasarım

Orçun ANDIÇ
Hasan Can ÇAKIR

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PRESENTATION

The ship recycling (SR) sector in the Aliağa District of İzmir, where ships that have completed their economic life are dismantled, provides raw materials to various sectors, especially the iron and steel industry, and plays a critical role within regional production.

İzmir Aliağa Ship Recycling Sector Analysis aimed to analyse the value-creating activities in this industry branch, as one of the sectors that make up İzmir's blue economy, and to define the steps that will increase the contribution of the sector to İzmir's economy. In this context, the SR sector has been examined at the scale of the world, Türkiye and İzmir, the facilities operating in Aliağa have been analysed, and sustainable strategies and upgrade plans have been created that can increase the economic value and productivity created by the sector. The study, which included data analysis, stakeholder interviews and reporting dimensions, was completed in seven months.

We hope that İzmir Aliağa Ship Recycling Sector Analysis will shed light on the policies for the development of the sector and the actions to be conducted in this area.

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ABBREVIATIONS AND DEFINITIONS

CDS :Credit Default Swap

CS :Chamber of Shipping

DWT :Deadweight Ton; overall weight comprising of the freight, passenger, provisions, fuel, water, ballast, oil, personnel carried by the ship.

EC :European Commission

EU :European Union

GEMİSANDER :Ship Recycling Industrialists' Association

GT :Gross Registered Tons; the volume unit obtained as a result of finding the sum of the ship's under deck and living quarters volumes in the metric system and dividing the sum by 2.83 m3**.**

HKC :Hong Kong Convention

HSE :Health Safety and Environment

IHM :Inventory of Hazardous Materials

ILO :International Labour Organization

IMO :International Maritime Organization

ISRA :International Ship Recyclers Association

İMEAK :İstanbul, Marmara, Aegean, Mediterranean and Black

İSGARD :Occupational Health And Safety Educational Research Association

LDT :Light Displacement Tonnage

LNG :Liquefied Natural Gas

LPG :Liquefied Petroleum Gas

LWT :Lightweight Ton; sum of equipped dry hull weight, hull weight and machine and equipment weight.

MARPOL :International Convention for the Prevention of Pollution from Ships

MEPC :Marine Environment Protection Committee

MGS :Turkish National Vessel Registry

OHS :Occupational Health and Safety Sea Regions

SR :Ship Recycling

SWOT :Strengths, Weaknesses, Opportunities, Risks

USA :United States of America

EXECUTIVE SUMMARY

More or less all materials comprising a ship can be recycled or reused. In maritime sector, ships that completed their technical and economic life are withdrawn from service to be replaced by more efficient and environment-friendly vessels that comply with the new demands. Ships that reach the end of their service lives are subjected to shipbreaking, thus supporting the renewal of the ship fleet and also providing raw materials, added value and employment opportunities for the country's economy by way of the ship recycling sector.

Within the worldwide SR industry, Türkiye is the country that processes the most scrap steel after Bangladesh, India and Pakistan. The raw material needs of shipbuilding and subsidiary industry are met through shipbreaking activities carried out at 22 SR facilities operating in İzmir Aliağa. Approximately 10 thousand people are employed in the sector together with the subsidiary industry. Reducing the amount of imported scrap demand saves about 100 USD per ton in cost. When the average scrap price is accepted as 500 USD/ton, it is seen that one million tons of scrap metal to be produced in İzmir Aliağa SR facilities contributes approximately 500 million USD to the economy.

The number of ships to be recycled is ever increasing throughout the world. Compared to the production to be made from iron ore, when steel is obtained from scrap with SR, energy is preserved by 74%, raw material resources by 90%, while water consumption is reduced by 40%, water pollution by 74%, air pollution by 86% and mine wastes by 97% (GEMİSANDER, 2020b). In this respect, it is seen that the SR sector supports the protection of the environment.

Projects and policies towards carrying out the SR process using modern methods, appropriate techniques and technologies are of great importance in terms of contributing more to the regional economy with more efficient and healthy production. The sustainability of the SR sector may only be possible with facilities that are environmentally friendly, transparent, constantly inspected, employing conscious and trained personnel, and possess infrastructure and storage areas in accordance with international rules and regulations.

In this study, initially, the world SR industry was examined and shipbreaking in Bangladesh, India and Pakistan, which had the largest share in shipbreaking, was evaluated. IMO, ILO, Basel and Hong Kong Conventions and European Union Ship Recycling Regulations were examined as critical international regulations in shipbreaking. In this context, SR methods used in the world and in Türkiye were discussed.

The current situation, and the infrastructure and basic operation steps of the İzmir Aliağa SR sector were examined in detail and SWOT, Pareto, Five Forces, Kaizen, PESTLE, Six Sigma and Resilience Engineering and Principles were used for sector analysis. As a source of information, the results of the extensive literature reviews, SR facility visits, interviews with relevant stakeholders and surveys were used. After synthesizing the obtained information, upgrade plans for İzmir Aliağa SR facilities were prepared.

Solutions were developed for the problems and deficiencies observed in the following areas with the upgrade plans covering the project proposals required for the production facilities to be efficient, sustainable and durable.

- · Physical Infrastructure
- · Machinery, Equipment and Technology
- · Knowledge and Experience
- · Human Resources
- · Financial Resources
- · Relations with Suppliers, Industry Actors and Public

Studies for the identified needs of SR facilities should be supported by rational and holistic policies. It is observed that especially infrastructure investments come to the fore as a necessity to increase the benefits provided by the sector to İzmir and the surrounding regions. The sector strives to become a more environmentally friendly industry in line with national and international regulations, competitive conditions and today's priority of sustainability. Developing the relations of SR facilities together with public institutions, universities, non-governmental organizations, media organizations and international stakeholders will also contribute to the strengthening of the sector. Keeping up with the global developments, changes and technology of the İzmir Aliağa SR sector will provide benefits in terms of making the sector more durable, efficient and sustainable.

In this study consists of eight sections, the first section covers information about the purpose, method and material. In the second part, the current situation of the SR industry on a global scale, and in the next section, the SR techniques that are widely applied throughout the world are examined. Within the scope of the fourth section, the detailed situation assessment of the İzmir Aliağa SR sector has been conducted and the recycling processes and waste management have been discussed. The risks that are frequently experienced in the SR industry are examined in the fifth section. The sixth section includes the sector analysis conducted through different methods. Developed upgrade plans, detailed evaluations and results form the content of the final two sections.

CHAPTER 1.

Introduction

1.1. Significance and Purpose of the Study

Although the efficient operation of conventional ships depends on various factors, the average life of the ships is around 25 years. Recycling ships made of sheet metal that complete their economic life is the most environmentally friendly approach. After the valuable parts to be sold as second-hand are removed from the ship, the sheet metal stripping and shredding processes are carried out in ship recycling (SR) facilities. The dismantled parts are brought to the industry for reuse, either by surface cleaning and painting or by melting them in iron and steel plants and rolling mills.

It is very important to recover the raw materials and equipment contained in ships or marine structures that have completed their economic life and may pose serious risks to the environment and people. For this purpose, dismantling operations are carried out at SR facilities. With SR, approximately 95% of scrap ships, 98% of which are composed of steel, can be reused (GEMİSANDER, 2020a). It has been observed that when steel is recovered from scrap by recycling, energy is preserved by 74%, raw material resources by 90%, water consumption by 40%, water pollution by 74%, air pollution by 86% and mine wastes by 97% (GEMİSANDER, 2020b). Performance of SR activities in Aliağa contributes significantly to the regional economy as well as the Turkish economy and the shipbuilding and shipyard sector. When a ship is dismantled in accordance with relevant rules, dangerous materials can be disposed of without endangering the environment and workers' health. The efforts carried out at the facilities in Aliağa toward fulfilling the standards determined at the national and international levels make a great contribution to the establishment of occupational health and safety as a culture. SR is recognised as a "green industry" by the International Maritime Organization (IMO) as it contributes positively to the conservation of energy and resources at global scale (IMO, 2021).

Shipbreaking is a heavy industry; furthermore, considering the dangerous materials carried by the ships and the hazardous materials that are likely to be used in shipbuilding, it can be said that it inherently contains many risks in its nature. In order to minimize the harm of such risks to human health and the environment, there are rules defined by organizations such as IMO and ILO, international conventions and regulations such as Basel Convention, Hong Kong Convention, European Union Ship Recycling Regulation, and countries with SR facilities have their own rules and regulations. However, a global unity has not been achieved on the full implementation of these regulations and rules. The desire of ship or fleet owners to earn more from the sale of their scrap ships leads them to South Asian countries (Bangladesh, India, Pakistan) where recycling accounts for about 83% of the shipbreaking industry (NGO, 2009). However, this trend causes serious threats to the environment and human health.

According to the SR industry 2020 data, Türkiye is the fourth country in the world ranking in respect to performing the most dismantling. When the weight of empty ships processed in the world in 2020 is examined, it is observed that Türkiye has a market share of 14%. The tonnage of ships to be recycled is increasing every year throughout the world and our country has the potential to increase its market share in the SR sector.

The aim of this study is to analyse the ship recycling sector, which possesses an important place within İzmir's economy and is also one of the components of the coastal and marine economy in the region, and also to define the steps that will increase the value created by the sector and its contribution to İzmir's economy. It is aimed to strengthen the ship recycling industry in terms of efficiency, sustainability and resilience. Progress towards this goal has the potential to create a significant added value for Türkiye as well as for İzmir.

1.2. Material and Methodology

Within the scope of the study, the SR industry throughout the world and in Türkiye is examined, and the problems experienced by the sector and the international rules and regulations concerning the sector are evaluated. The risks that the industry is exposed to are discussed and the operational processes applied are presented. By using SWOT, Pareto, Five Forces, Kaizen, PESTLE, Six Sigma Analysis and Resilience Engineering and Principles, the factors that add value to the sector are examined and upgrade plans are created through the suggestions developed.

Information is obtained through literature review, on-site field investigations, and survey applications, and the strengths and weaknesses of the industry, as well as the opportunities and threats it faced, are analysed. In the later stages of the study, upgrading plans for the sector are created in line with the results of the relevant analysis.

In the studies carried out, at the points wherever there is a lack of data on a regional and national scale, data obtained from different studies were included within the scope of the literature review. In addition, support was obtained from the information gathered from field interviews and surveys at points where clear and reliable data regarding the upgrade plans and evaluations were not available.

CHAPTER 2.

Ship Recycling Industry and Relevant Regulations

2.1. Introduction

For ships that have completed their economic life, there are applications such as dismantling and recycling, turning into artificial reefs by sinking in the sea, fixing them on land or in the sea and using them for different purposes. Among these, the recycling of ships can be considered the most environmentally friendly and economical option.

SR is the reverse of shipbuilding. This transformation begins with the ship owner's decision to scrap a ship. It then involves a process where the ship is disassembled, its useful parts are recycled, some useful parts are sold directly to the second-hand market for reuse, and the harmful substances present on the ship are disposed of and controlled. This process is a production method in which the materials obtained by dismantling are utilised, that is, the scrap material is converted into valuable goods.

Research on the shipbreaking industry draws attention to the fact that this industry is quite dangerous in nature (Greenpeace, 1999b). Hazardous materials that may be found on a ship subject to be dismantled and the dangers that may occur during the operation can cause serious disasters. International rules and regulations must be complied with in order to eliminate or at least reduce the risks that threaten occupational health and safety.

The Covid-19 epidemic, which has affected the whole world recently, has also negatively affected ship owners and operators, and there has been a serious increase in their desire to recycle their ships. The cruise sector was the most affected by this epidemic (GEMİSANDER, 2020a). Since the ship operators had difficulty in meeting the personnel, anchorage, insurance and other expenses of the ships that could not sail during the epidemic, they changed the route of the ships to Aliağa SR facilities, which are registered on the EU Ship Recycling Facilities list.

Considering the nature of the activity carried out in the SR process and the dangerous substances carried by the ships, it is observed that this process is a very sensitive process that can bear health, safety and environmental problems. Therefore, the regulations applied in the SR industry gain more importance, and public surveillance on environment and safety and the implementation of comprehensive regulations regarding the industry come up to the agenda.

The fact that the shipbreaking process is carried out under the lack of environmental awareness, security weakness, and inadequacies of global and local rules poses serious threats to the environment and people. As such, this situation has forced international institutions and organizations to develop internationally valid regulations and standards. IMO's Hong Kong Convention (HKC) and European Union's (EU) Ship Recycling Regulation are examples of such regulations.

SR regulations have come a long way since the EU enacted rules and regulations modelled after the Hong Kong Convention. HKC and the similar EU legislation both aim to ensure that ships that are recycled after reaching the end of their operational life do not pose risks to human health, safety and the environment. The EU's rules and regulations, especially regarding SR, are contained in the EU Ship Recycling Regulation, which came into force in December 2019. Ship owners who are willing to recycle their ships should consider the legal implications of not complying with rules and regulations and should sell their ships to facilities that perform SR activities according to international rules and regulations. IMO and EU's SR regulations are in compliance with international Health, Safety and Environment (HSE) standards. Considering HSE measures in the SR industry will increase operating costs. Therefore, it is important for SR sites to increase their production efficiency in order to remain competitive.

SR is the final stage in the ship's life cycle, any valuable material can be reused or recycled during this conversion. In this respect, the variety of materials that can be recycled on a ship is quite large. By weight, approximately 95% of all materials and equipment owned by the ship can be recycled (Gunbeyaz, 2019) (Table 1).

TABLE 1. Materials that can be recycled on a ship (Gunbeyaz, 2019).

Ship Section	Valuable Components in Recycling
Ship hull	Ship hull and superstructure (steel) Structural bulkheads, decks (steel) Doors, hatches and channels, seats, supports and posts (steel) Control surfaces Structural castings, wrought iron, fasteners
Cargo gear	Cargo equipment and machinery systems Cargo, loading/unloading systems Cargo cranes and covers Cargo handling equipment Elevators and lifting equipment Portable lifting equipment
Equipment	Ship-specific equipment, machinery, navigational equipment Manoeuvring machines Mooring equipment, communication equipment Gyro, compass, antennas, displays, alarms, panels Radar, navigational devices Propellers, rudders, stabilizers Anchor, capstan Television, radio and satellite communications equipment
Accommoda-tion and work-ing environment equipment	Lifeguard equipment and systems Accommodation, food, sanitary systems General fasteners Boats and lifeboat equipment Furnishings and fasteners Galleys, laundries and workshop equipment Accommodation and medical stores
Machine Main Components	Ana ve yardımcı motorlar, tahrik sistemi Kazanlar ve jeneratörler. Ana makine, yardımcı makinalar Türbinler, jeneratörler
Systems for Ma-chine Main Components	Main and auxiliary engines, propulsion system Boilers and generators Main machine, auxiliary machines Turbines, generators
Shared Systems	Systems serving main engine components (fuel, etc.) Lubrication, exhaust, automation systems Fuel service systems

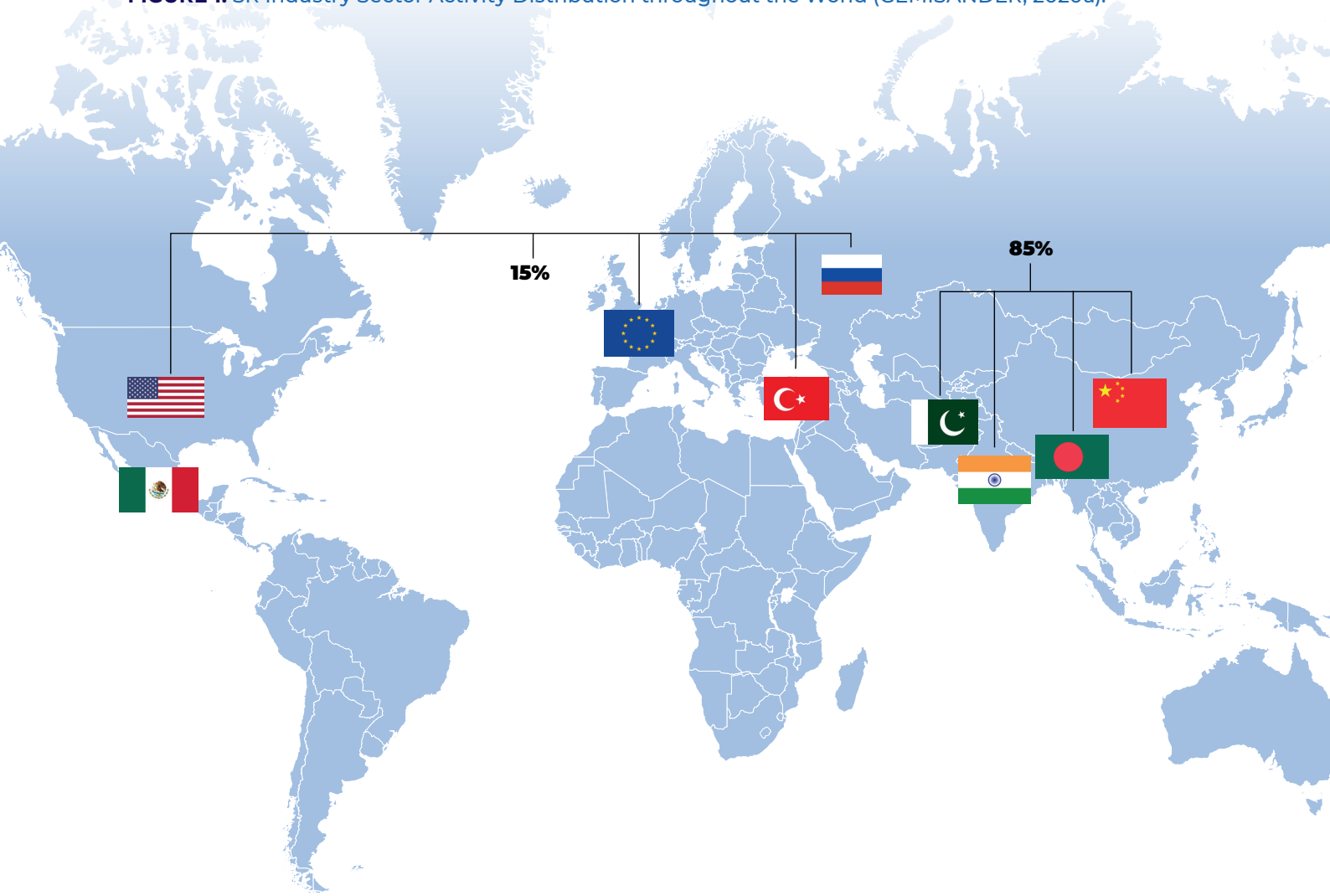
Obtaining metal from ships by recycling will be beneficial as in enabling less metal ore to be extracted from nature, since the ship's weight is mostly from metals. In addition, less energy is used in the production of steel with SR compared to production from ore, as well as less carbon dioxide emissions to nature. If a comparison is made for steel, which is the most used material in the shipbuilding industry: "It is known that about 7400 MJ of energy is required and 2200 kg of carbon dioxide is released in the production of one ton of steel from hematite ore. However, approximately 1350 MJ of energy is required to produce one ton of steel from scrap and 280 kg of carbon dioxide is released" (Yanmaz, 2005).

SR includes a variety of chemicals, activities, and processes that may expose workers to hazardous situations that can cause health problems, injury, or even death to workers. For example, asbestos, which is likely to be found on ships, is one of the major toxic materials that threaten worker health. In addition, hazardous wastes that may arise during shipbreaking processes pose an environmental risk when not properly managed. Samples taken from the soils around the shipbreaking facilities were observed to also confirm this risk. (Greenpeace, 1999a; Greenpeace, 1999b; Greenpeace, 2001a; Greenpeace, 2001b; Greenpeace, 2002). Especially in third world countries, SR facilities have deficiencies in regards to legislation, safety, environmental awareness and emergency preparedness plans. The fact that such countries do not comply with global rules and do not have local rules and regulations causes ships to be dismantled under undesirable conditions, thus negatively affecting nature and human life.

2.2. World Ship Recycling Industry

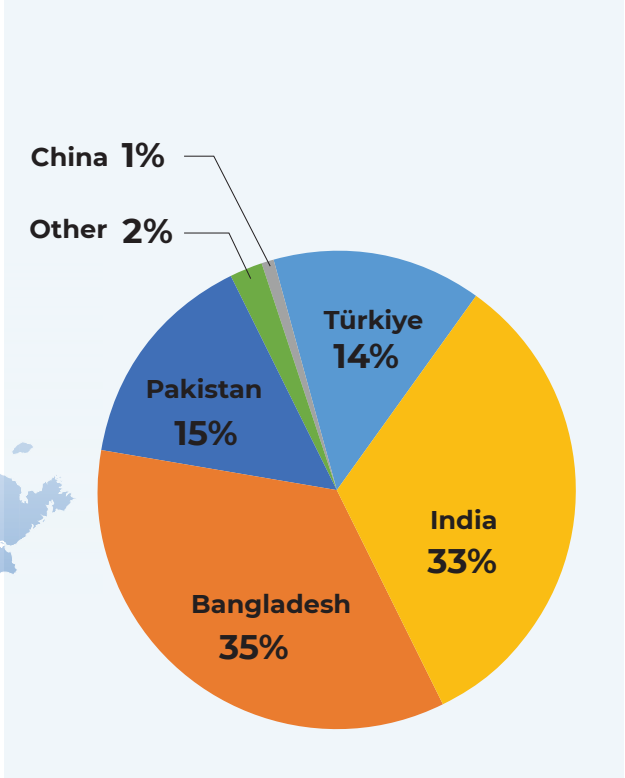
On the one hand, the SR industry helps the renewal of the global ship fleet and the balance of ship supply and demand in the freight market, and on the other hand, it contributes to sustainability by recycling millions of tons of scrap material. The activity of the industry first started in industrialized countries such as the USA, England and Japan after the Second World War to recycle damaged ships. In the following years, due to low labour costs and high demand for scrap steel, SR has largely shifted to South Asian countries. Today, the distribution of activities in the sector can be observed as shown in Figure 1.

FIGURE 1. SR Industry Sector Activity Distribution throughout the World (GEMİSANDER, 2020a).



According to 2020 data, Bangladesh, India, Pakistan, Türkiye and China dismantles 98% of the total LDT (light displacement tonnage – empty ship weight) (Figure 2). Bangladesh is the leader among the countries performing LDT, and according to 2020 data, it has transformed 35% of the total LDT within the market. In terms of LDT rates, this country is followed by India with 33%, Pakistan with 15% and Türkiye with 14%.

FIGURE 2. The Ratios of Lightweight Displacement Tonnage Processed by the Countries Performing SR in the World as of the year 2020 (NGO, 2020).



Bangladesh, India and Pakistan use the beaching method of ship recycling, the most primitive method in terms of human and environmental safety. Although they are quite dangerous for the environment, work and worker safety, the low labour costs, geographical conditions and geological features of these countries make them preferable for SR activities.

The highest number of ships recycled in the world between 2013-2021 August occur to have been reached in 2014 (Figure 3) (İMEAK Chamber of Shipping, October 2021). (Figure 3) (IMEAK Chamber of Shipping, October 2021). The number of ships dismantled in 2014 reached 1139. The second year with the highest number of shipbreaking was 2016, and a total of 1012 ships were dismantled this year. When these data are examined, it is observed that the lowest recycling took place in 2020 with 599 ships. This shows that although the dismantling of large-scale cruise ships has increased with the emergence of the Covid-19 pandemic, there has been a decrease in the number of dismantled ships in the sector in general. It is predicted that the decrease in the number of ships may be a result of the negative impact of the SR industry due to the recession in the global economy and the quarantine practices implemented by the countries.

FIGURE 3. Ships Subjected to SR in the World by Years (number of ships) (İMEAK Chamber of Shipping, October 2021).

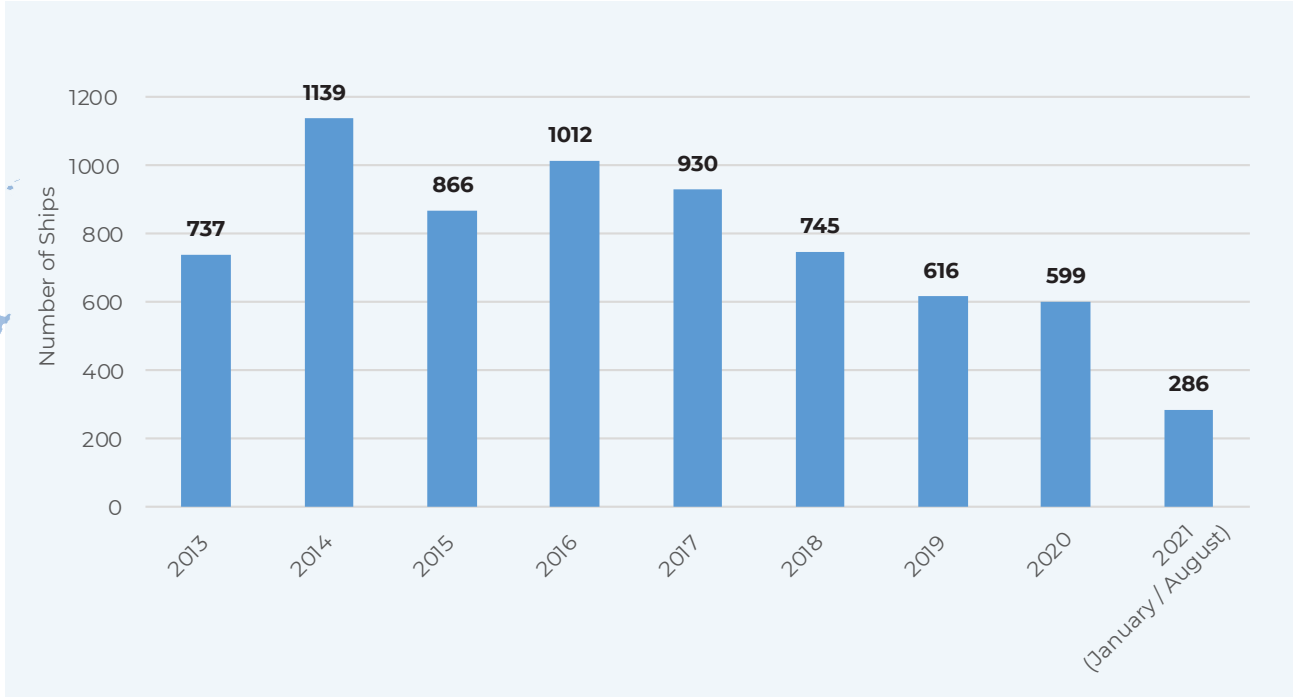


FIGURE 4. Number of Ships Dismantled in the World in the year 2020 (NGO, 2020)

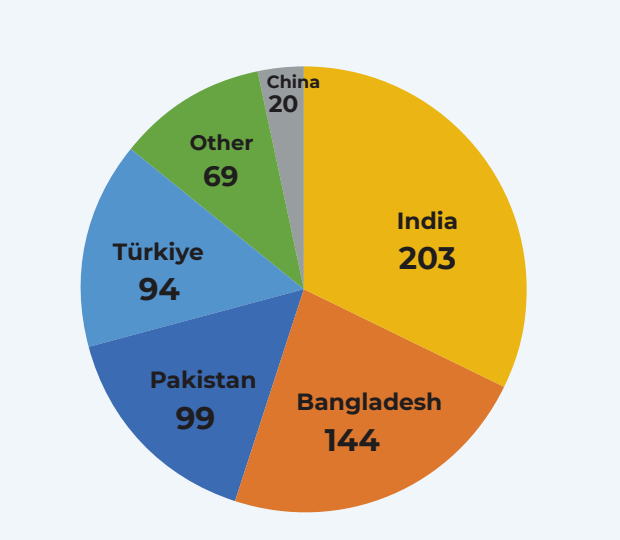
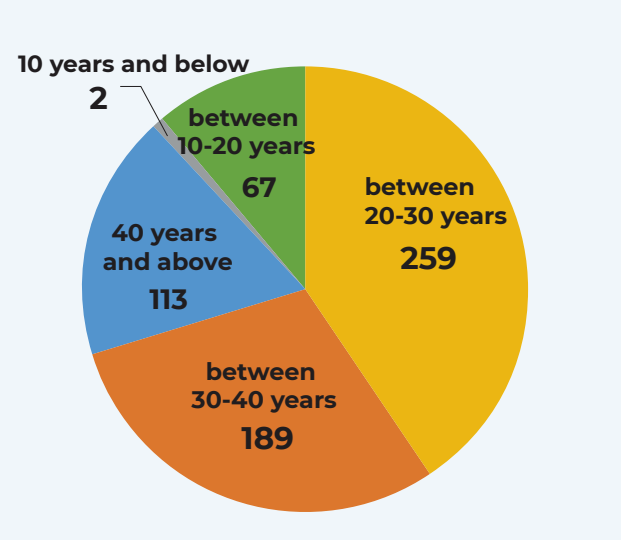


FIGURE 5. Ages of Ships Dismantled in the World in the year 2020 (NGO, 2020)

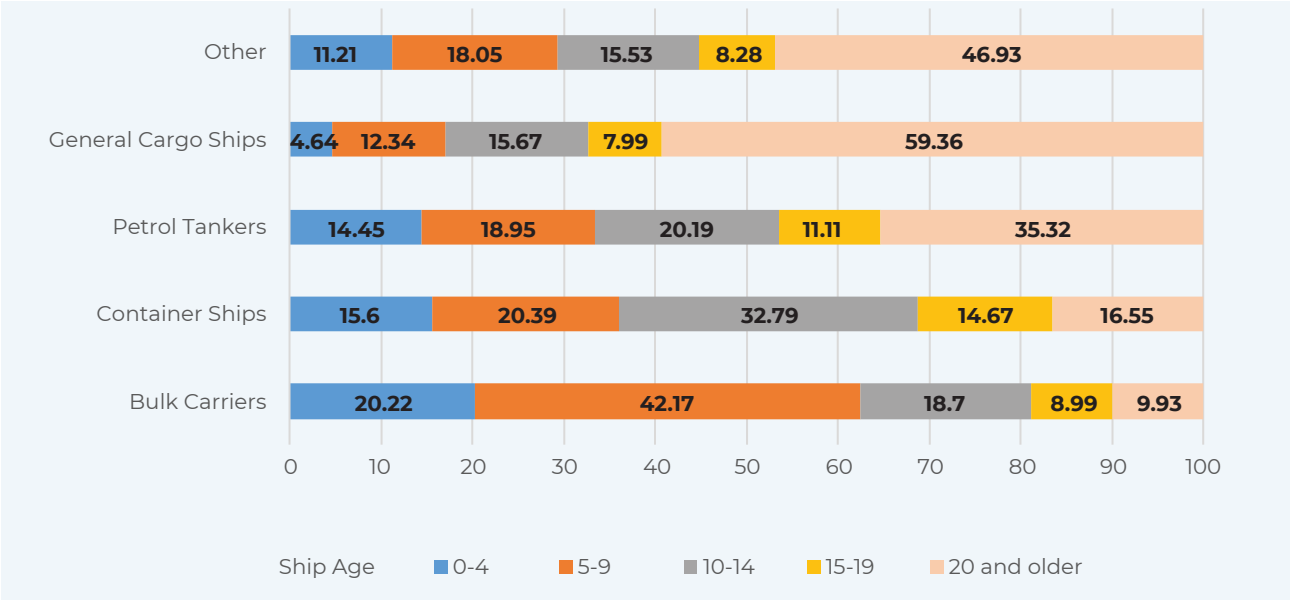


In regards to the number of ships dismantled in the world in 2020 (NGO, 2020), India comes first with 203 ships. Bangladesh (144 ships) and Pakistan (99 ships) follow India, respectively (Figure 4).

The number of ships dismantled in Türkiye in 2020 is 94. When the ages of the ships that are subjected to recycling in the world are examined for 2020, it is observed that 41% (259 ships) were between 20-30 years old, 30% (189 ships) were between 30-40 years old and 18% (118 ships) were 40 years old and older (Figure 5).

According to the 2019-2020 age distribution data of the world shipping fleet, 33.6% of the ships are 20 years or older (Figure 6). Bulk freighters are the youngest with an average age of 9.28 years, followed by container ships (9.91 years) and oil tankers (10.38 years). On average, general cargo ships are the oldest ship type with an average age of 19.46 years.

FIGURE 6. Age Distribution of the World Trade Fleet by Ship Type as of 2019-2020 (UNCTAD, 2020)



2.2.1. Bangladesh

In the South Asian country of Bangladesh, most of the SR activities are carried out on the approximately 15 km length of the Sitakunda Beach of the Bay of Bengal, near the city of Chittagong. There are several different reasons for the development of SR in Bangladesh, which is carried out in approximately 100 facilities located along the beach (Hossain, 2015). These reasons are as listed below:

- Presence of a long beach with soft sand and muddy ground
- Inclined terrain that facilitates the towing of ships to the shore
- Large tidal amplitude in the region
- High demand for recovered materials and equipment
- High number of workers and low labour cost
- 100% of recycled material being able to be reused locally

The main reasons for choosing the current location in Chittagong (Fauzdarhat to Kumira) for the SR industry in Bangladesh can be explained as follows:

- Having a shoreline not used for a long time, suitable for beaching SR technique
- Being suitable and available to support SR, a heavy industry branch
- Being at an accessible distance to the relevant industry branches
- Having a direct road connection with the relevant industries
- The absence of any sensitive areas around the region
- Coastal slope that facilitates the towing of ships coming from the open sea to the shore
- Presence of a large natural tidal difference,
- Low labour cost and availability of workers

The SR industry has a significant impact on Bangladesh's socio-economic development. These contributions are listed below:

- Scrap ship contributes to the sustainable economic development of the country in the absence of iron ore.
- Approximately one million people are directly or indirectly related to this industry.
- Annual income from the sector is over 130 Million Dollars.
- Provides raw materials for related industries such as local shipbuilding industry, construction industry, rerolling mills, steel mills, oxygen mills, cable, ceramics, and furniture factories.
- Supports local shipbuilding by providing steel plates, machinery, equipment, boats, navigation aids, electrical and electronic equipment, firefighting and life-saving equipment, deck gear and a wide range of marine supplies etc.

Also, the contributions provided by the SR industry to Bangladesh are listed below:

- More than 60% of materials and machinery for local shipbuilding come from the local shipbreaking/recycling industry. Without SR industry products, inland, and in some cases coast shipbuilding sector in the country would have serious problems.
- The shipbreaking/recycling industry indirectly supports another two million people in the country involved in the shipbuilding industry.
- About 35,000 tons of processed wood and furniture are provided annually, which prevents deforestation.
- The industry allows efficient use of coastal areas as an economic/commercial area.
- Forming a kind of barrier on the coast prevents erosion and ensures land reclamation.
- The contribution to the national economy is approximately 2 Billion USD.

It is estimated that more than three million people and the whole country's economy would be severely affected if the local shipbreaking/recycling industry ceased to operate. This would reduce the gross domestic product and hinder the entire national development process. Therefore, the SR industry is vital for Bangladesh (Hossain, 2015).

2.2.2. India

India, another South Asian country, has the world's largest SR facilities in Alang-Sosiya, located on the west coast of Gujarat. Alang currently has around 120 active recycling facilities that dismantle ships at the end of their operational lives to remove various types of scrap and equipment for recycling and reuse purposes (Hiremath, 2017). These facilities employ approximately 60,000 people. SR operations in the region started in 1982 and have grown more than 100 times in the past period. Indian Finance Minister Nirmala Sitharaman announced in the February 2021 budget talks that they aimed to double the SR capacity by 2024 and to attract more ships from Europe and Japan to India (Sitharaman, 2021). In this context, it is planned to add 15 new parcels to Mathavda village, which is adjacent to Alang, for the currently discussed capacity increase. Alang owns 153 plots or shipbreaking facilities built on a 10 kilometre long beach in the Bhavnagar district. It is said that only 131 parcels are allocated for shipbreaking activities and only 80 plots are used for shipbreaking, which means that approximately 48% of the current breaking capacity at Alang is currently unoccupied.

2.2.3. Pakistan

Pakistani shipbreaking and recycling is carried out in 132 parcels along a 10 kilometre beach in Gadani within the Persian Gulf, 46 km west of Karachi, the country's largest city (Hameed, N., 2019). In the 1980s, the shipbreaking and recycling industry played an important economic role in Pakistan and supplied a significant amount of recyclable scrap steel to the iron and steel industry. In particular, within the last two decades, the Pakistani government's inconsistent policies, hasty attitudes towards ship imports for scrap materials, the additional taxes imposed and the neglect of the sector have adversely affected the SR sector in the country, and it has not been able to combat the competitive policies of India and Bangladesh in shipbreaking. Therefore, it has regressed to the third place in the world in LDT processing rates according to 2020 data (Figure 2).

2.2.4. China

China is the only Asian country where the beaching method is not applied in ship dismantling. In China, shipbreaking takes place at 90 shipbreaking sites located mainly in the deltas and the lower reaches of the Pearl and Yangtze rivers (Du, Zhu, Zhou, & Wong, 2019). The major shipbreaking facilities are located in Zhang Jiagang in Jiangsu province. These facilities have the capacity to recycle large vessels, pioneering the green shipbreaking industry. China is also a founding member of the International Ship Recycling Association (ISRA). The official beginning of the SR industry in China dates back to the 1960s. China has also been the world's leader among the countries that have performed SR in the past, and by 1993 almost half of the ships were scrapped in China. However, the SR sector in China faced some fluctuations depending on the general market, and it lost the lead due to being adversely affected by the increasing taxes on imported tonnage and the increasing scrap prices.

2.3. Ship Recycling Industry Regulations

2.3.1. IMO

The International Maritime Organization (IMO) addressed the issue of shipbreaking in the Marine Environment Protection Committee (MEPC) held in 2000. In this context, a research group was formed to examine the current situation.

The MEPC committee completed the guideline and published their resolutions in 2003. With this guide, the committee provided recommendations to all stakeholders of the dismantling industry and ship owners about flags, ports, recycling areas, and international organizations, stressing the importance of evaluating each dismantled piece.

This guide was designed as a guide that can be consulted at all stages of the shipbreaking operation, when it comes to safety and health. For ships, the idea of the 'Green Passport' application, which includes an inventory of all materials and equipment harmful to the environment and health, has been proposed. According to the proposal, the ships should carry this passport throughout its operational life.

2.3.2. ILO

The International Labour Organization (ILO) was established by the United Nations in 1919 to make international regulations on working life and social policies. The ILO is one of the specialised organizations on human rights. In addition to the general rules about working life, it has also published a guide that includes rules about shipbreaking (ILO, 2004).

The aim of the ILO-2004 guide (ILO, 2004) is to protect the workers employed in the shipbreaking sector from occupational accidents and to reduce the injuries and accidents that may occur in the workplace. Improving the management of safety and health conditions in the workplace is also among the objectives. A structured process has been established between the roles and responsibilities of authorities, employers, employees and other stakeholders. It is among the guide's objectives to support the implementation of the Occupational Safety and Health (OSH) management system, by way of sharing knowledge and experience.

2.3.3. Basel Convention

The Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, known as the Basel Convention, entered into force in 1992. The main purpose of the convention is to keep the circulation of hazardous waste under control (BASEL CONVENTION, 2011). An amendment was made in 1995 (Basel Ban) and sending hazardous waste from OECD and EU countries to non-OECD countries was thus prohibited (EC, 2008). Hazardous wastes are listed in Annex-I and II of the convention, and the characteristics of risks are specified in Annex-III. In Annex-IV, information on how to dispose of wastes is given and the transfer of wastes is described in detail.

Specific arrangements are required regarding the Basel convention and the application of the Basel Ban to ships destined for dismantling, since in non-OECD waters the flag can be changed and the ship can be sent to a non-OECD country for dismantling.

This convention contains provisions on the circulation of risky wastes and does not cover applicable provisions for shipbreaking. For this reason, the parties to the Basel Convention started the Hong Kong Convention process in the conference held in 2004 with the participation by IMO. Furthermore, on the 5th of December 2019, the Basel Ban Amendment became international law. The Basel Ban amendment, adopted by the parties to the Basel Convention in 1995, prohibited the export of hazardous wastes from the European Union, the Organization for Economic Cooperation and Development (OECD) and Liechtenstein member states to all other countries

2.3.4. Hong Kong Convention

Shipbreaking Guide prepared by the IMO-MEPC Committee was completed in 2003, thereupon, it was decided to carry out a further action in 2005. The International Hong Kong Convention (HKC) was accepted in 2009 to ensure safer and more environmentally friendly dismantling of ships, but the number of signatory countries could not be reached to the desired level. Türkiye is the first country to sign the convention covering the entire life cycle of the ship from design to dismantling.

When the Convention enters into force, ships will keep the “Inventory of Hazardous Materials (IHM)”, which includes the list of hazardous materials they transport, on board at all times. With the convention, annual surveys will be carried out on the ship and it will be determined whether the materials in the inventory are still on the ship.

HKC includes the dismantling of ships at shipbreaking facilities that meet health and safety conditions. According to the convention, the facilities subject to shipbreaking activities must submit their SR facility plans. These plans include environmental protection, safety and education, emergency preparedness and response and monitoring systems (Hougee, 2013).

Although it is a more detailed action compared to the Basel Convention, the end-of-life status of the ship under the HKC is not clarified (Bhattacharjee, 2009; Sundelin, 2008; Jain, 2013). The convention has not entered into force as of yet, because not enough countries have signed it.

2.3.5. European Union Ship Recycling Regulation

The European Parliament adopted the Ship Recycling Regulation (2013) (European Commission (EC), 2016) in order to reduce the negative effects of the dismantling of ships flying the EU flag. This regulation has been put forward in order to prevent accidents and injuries caused by shipbreaking operations and to prevent deterioration of human health and environmental conditions. The regulation contains rules that ensure the proper management of risky wastes. The EU supports the completion of the HKC convention's processes and its rapid entry into force.

According to the regulation, every ship has to carry a Hazardous Materials Inventory, which includes where the risky materials are used. Shipbreaking operation requests of ship owners are presented. In addition, how the dismantling plan will be made is also reported in this regulation. The issue of conducting risky material surveys regularly and in accordance with the IMO guide is also covered in the scope of this regulation.

The regulation collects shipbreaking shipyards that comply with EU rules under a list. From 31 December 2018, ships can only be recycled at one of the listed European ship recycling facilities. These facilities can be found in both EU and non-EU countries. To be included on the list, facilities must comply with a number of requirements regarding worker safety and environmental protection. The list is regularly reviewed and updated to add new facilities or remove existing ones from the list.

The new legislation allows ship owners with EU Flag vessels to recycle ships at non-OECD country facilities. A necessary condition is that the facilities fulfil their obligations regarding environmental and safety conditions. Ship owners will be able to choose a facility from the list published by the EU and have the shipbreaking operation performed at the facilities that meet the conditions. The EU commission set additional safety and environmental rules based on the HKC.

2.4. Results and Evaluation

SR is seen throughout the world as the most environmentally friendly and economical solution for ships that have completed their economic life. Nearly 83% of SD activities are carried out in developing countries (Bangladesh, India and Pakistan), and the fact that these countries do not operate in accordance with global standards and rules, do not have national standards and instead have a lack of adequate inspection mechanisms bring along serious threats. The use of the beaching method, which is still the most primitive method in SR operations in these countries, does not meet the global HSE standards. China is the only Asian country where the beaching dismantling method is not implemented in shipbreaking.

Recycling of ships is an inevitable process. In order for this process to be carried out in the safest and most efficient manner, international organizations are preparing and developing various conventions and regulations. All institutions and organizations serving in the SR industry should be encouraged to comply with these regulations. More stringent measures should be taken in the implementation of all processes from the detection of hazardous materials and wastes to their disposal. Otherwise, risks related to the environment and work and worker safety will continue to exist.

CHAPTER 3.

Ship Recycling Methods Implemented in Facilities

The fundamental philosophy of the SR activity is to disassemble and utilize everything that can be reused on the ship, and to dispose of harmful wastes in accordance with relevant rules. Various methods are used for recycling processes by the five countries with the largest market shares (Bangladesh, India, Pakistan, Türkiye and China) and other countries. Although the ship cutting processes involved in the recycling process are the same, how and where the ship is berthed differs. In this section, different methods used in shipbreaking facilities will be discussed.

3.1. Beaching

Beaches with high tide may be used for this method of shipbreaking. This method has been widely adopted in Bangladesh, India and Pakistan, where the most shipbreaking throughout the world is realized.

The most important reason for the adoption of beaching method is its very low cost (Sarraf, 2010). This method is used in regions with high tidal amplitude. During the swell, the ship approaches the beach by using own propulsion system, and when the waters recede, it is pulled inwards as much as possible with the use of cranes.

The ship towed to the beach begins to be cut, the ship cut into big blocks falls with the effect of gravity; and after being brought to a size that can be carried, the structural blocks are transported to an inner dismantling area (Figure 7). The cut blocks are removed and when the remaining part becomes light enough, it is processed by being pulled inwards with the help of cranes (Gunbeyaz, 2019)

This method has significant flaws and risks. NGO Shipbreaking Platform, a non-governmental organization working to ensure the safe and environmentally sound dismantling of end-of-life ships worldwide, defines the risks involved in beach shipbreaking as follows:

- In case of emergencies, it is difficult to reach the beach, evacuate the injured, meet the requirements such as emergency response and firefighting equipment, ambulance and crane.
- It is essentially impossible for heavy cranes to enter the beach to transport the cut ship blocks or parts to the beach. For this reason, it is not possible to remove any heavy cut pieces if they fall into the water.
- The wastes from the ships towed to the beach and the metal wastes generated during the cutting mix with water.
- Hazardous wastes generated during shipbreaking cannot be controlled and they mix with the marine ecosystem due to tidal movements.

Although widely used due to not requiring much infrastructure and only low costs, it is one of the methods with the highest risk of harming the environment, human health and work safety. There are many accidents observed during shipbreaking where this method is used. While the ship is being cut off in an uncontrolled manner on the beach, the hazardous wastes present in the ship flow onto the beach, mix with the water and pose a serious threat to the health of the workers and the creatures living in the ecosystem. The use of this method is one of the driving forces that led to the creation of the HKC (NGO, 2009; Litehauz, 2013).

FIGURE 7. Beaching shipbreaking method

(BBC News, 2021)

(The Guardian, 2021)

3.2. Landing

With the landing method, the ship is towed ashore using a concrete floor to begin the disassembly process. The tidal amplitude is lower in regions where this strategy is applied. It differs from beaching shipbreaking as in using a highly equipped environment for shipbreaking.

With the SR process through landing method, it is feasible to take advantage of cranes of various sizes when the ship is being divided into blocks (Figure 8). Cranes are used in the process, which lowers the chance of accidents and environmental degradation. Mostly EU members and Türkiye utilize the landing shipbreaking technique (Hougee, 2013).

FIGURE 8. Landing shipbreaking method

3.3. Alongside

Alongside shipbreaking method is used mostly in China, USA and Belgium (Hougee, 2013).

In this method, the ship's primary structural components are disassembled once all the removable portions have been removed (Figure 9). Starting from the superstructures and descending vertically, the ship connected to the quay is dismantled (LR, 2011; Sivaprasad, 2010). Up till the bottom, the ship is disassembled piece by piece from top to bottom. To avoid any leakage into the sea, the liquids on the ship are released in a regulated manner in the meantime. Afterward, the double bottom block is either hoisted or pushed into the dry-dock depending on the shipyard's crane capabilities (LR, 2011).

FIGURE 9. Alongside shipbreaking method (Virahaber, 2021)

3.4. Dry-Docking

In this method, the ship is taken from the sea to a solid dock and dismantled with the help of equipment such as cranes. Since there is no connection with water, dismantling is carried out in safer and more environmentally friendly conditions compared to other methods. After the dismantling is done in a closed, sheltered dry-dock, the dock is cleaned. For this reason, when using this method, the damage to the environment is minimized. The dry-dock method has less environmental risks in shipbreaking compared to other methods (Hougee, 2013).

The ship to be dismantled is taken to the dry-dock, and the water in the dock is discharged during the performance of this process (Figure 10). Although the dry-dock infrastructure cost and space requirements are high, it provides a safer and environmentally friendly recycling opportunity.

3.5. Conclusions and Evaluation

Along the coastal areas with high tidal amplitude in some countries dealing in SR activities, shipbreaking is performed on the beach by using the advantages of this natural phenomenon. However, this method is the most uncontrolled in terms of environmental pollution and has the highest occupational safety risk. Wastes are dispersed in such a way that they cannot be cleaned and thus they mix directly with soil and water.

The dry-dock method is the most controlled and the least risky method. There are also advantages and disadvantages of other methods between these two extreme shipbreaking methods. Shipbreaking operations on shores and piers pose more environmental risks than activities carried out in dry-docks.

FIGURE 10. Dry-dock shipbreaking method

CHAPTER 4.

Ship Recycling Industry in Türkiye

SR is a significant industrial branch in Türkiye with the potential to lessen the country's reliance on iron scrap from other nations and enhance employment opportunities due to the sector's anticipated capacity growth. It may be noted that the scrap metal produced in the İzmir Aliağa SR facilities makes a considerable economic contribution given the pricing range of 450-500 USD/tonne of scrap metal.

The only country in the Mediterranean region where SR is practiced as a sector in Türkiye. Türkiye recycles 85% of ships flying the flag of the EU (GEMİSANDER, 2020a). Türkiye became the first nation to join the Hong Kong convention at a diplomatic meeting in 2009, demonstrating its commitment to conducting SR operations in compliance with the environment and human health. Türkiye is one of the 15 nations that comply with the SR Regulation issued by the European Union. But the SR market share for these 14 nations occurs to be only 2%. The top-ranking Asian nations in terms of SR were not eligible to be included in this list.

Türkiye is not the only party to the international conventions of the SR industry, but also strives to support and even be a leader in the creation of such regulations.

4.1. Shipbreaking History and Facilities

The first shipbreaking activities in Türkiye started in pre-Republican times. In respect to the earliest shipbreaking activities in the country, it is observed that İlhami Selçuk Söker performed such activities on the coast along Balat Hızır Çavuş Köprübaşı Bereket Sokağı (Golden Horn) (GEMİSANDER, 2021). Bandırma Ferry, which brought Mustafa Kemal Pasha and his comrades in arms to Samsun on 19 May 1919 to perform his duties of Inspector of the 9th Army Contingent, was sold to İlhami Selçuk Söker in 1925 with the decision of the Turkish Navigation Administration and dismantled in this region (T.C. Kültür ve Turizm Bakanlığı, 2021). In the same years, foreign ships were dismantled by Avram Kohen in Hasköy. Ertuğrul yacht, one of the most important ships in the history of the Republic, and many other ships were dismantled in the Golden Horn region. Shipbreaking activities, which continued until 1970, were later stopped due to the location of the Golden Horn. After this date, shipbreaking activities were shifted to Aliağa district of İzmir. Manisa, Çoruh, Batman, Turgut Reis tankers and Ankara passenger ships were the first ships to be dismantled in the Aliağa shipbreaking zone in the year 1977.

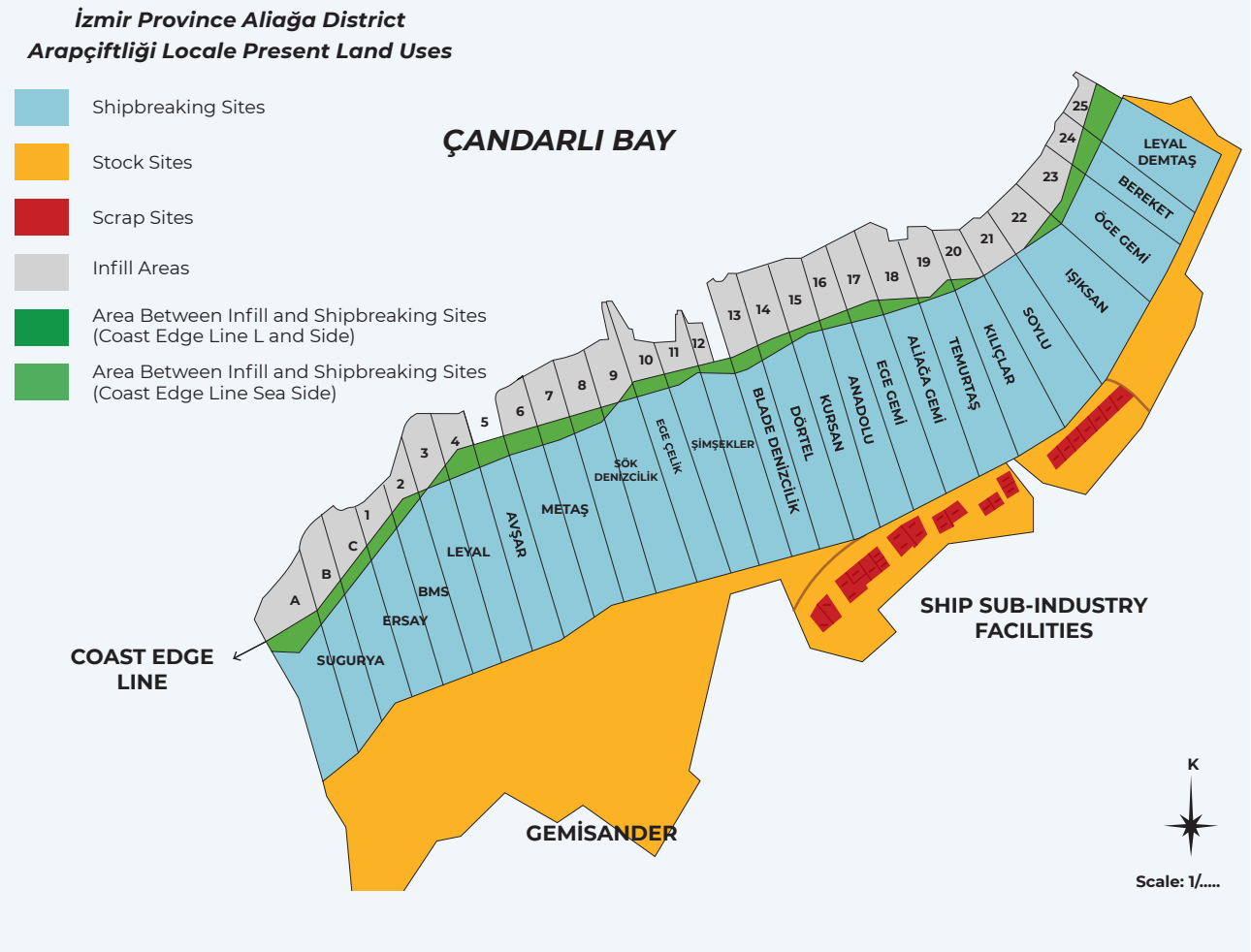
The area where the immovables with parcel numbers 1801, 1783, 1786, 1787, 4623, 5143, 7175, 6756, registered in the title deed and located inside Aliağa Arapçiftliği, was planned as İzmir Aliağa Shipbreaking Organized Industrial Zone, pursuant to the Board of Ministers decree with date 24.10.1974 and no. 7/8951 according to the letter of the Directorate General of Planning and Zoning with no. H.05-BPÇ-8-34-3023 and with the approval dated 24.10.1976. The land was expropriated by the General Directorate of Land Office with the approval of the Ministry of Public Works and Housing dated 28.10.1974 to realize the purposes stated in Article 2 of the law numbered 1164 and in accordance with Article 9 of the same law. The relevant area has been rented by the Land Office to companies that carry out shipbreaking activities for 5-year periods. However, with the Law No. 5273 with date 08.12.2004, the Land Office Law No. 1164 was amended as the Law on Land Development and Utilization. With Article 2, all assets, rights, obligations and all kinds of immovable properties of the Revolving Fund (excluding cash and service buildings and all kinds of tools and equipment) and other rights and obligations of the General Directorate of Land Office were transferred to the Housing Development Administration (TOKİ).

Officially, shipbreaking operations in Türkiye are currently only carried out in İzmir Aliağa zone. (Figure 11).

FIGURE 11. İzmir Aliağa Ship Recycling Zone

22 businesses that have earned Shipbreaking Authorization Certificates from the General Directorate of Shipyards and Coastal Structures of the Ministry of Transport and Infrastructure are permitted to deal in shipbreaking activities in Aliağa, operating over 28 parcels (Figure 12). Within Aliağa's borders, there are also numerous significant corporations and industrial facilities, including Petrol Ofisi, Petkim Petrokimya Holding, the TÜPRAŞ-owned İzmir Refinery, and the SOCAR-owned STAR Refinery.

FIGURE 12. İzmir Aliağa Ship Recycling Facilities (GEMİSANDER, 2020a)



Concerning the 22 shipbreaking facilities operating in 28 parcels in İzmir Aliağa District, it is observed that the facilities have a total area of 403,710 m2 and a capacity of 1,450,000 tons (Table 2). Leyal, Yazıcı, Sök, Şimşekler, Işıksan, Öğe and Leyal-Demtaş are the facilities with the largest capacity and area in the zone.

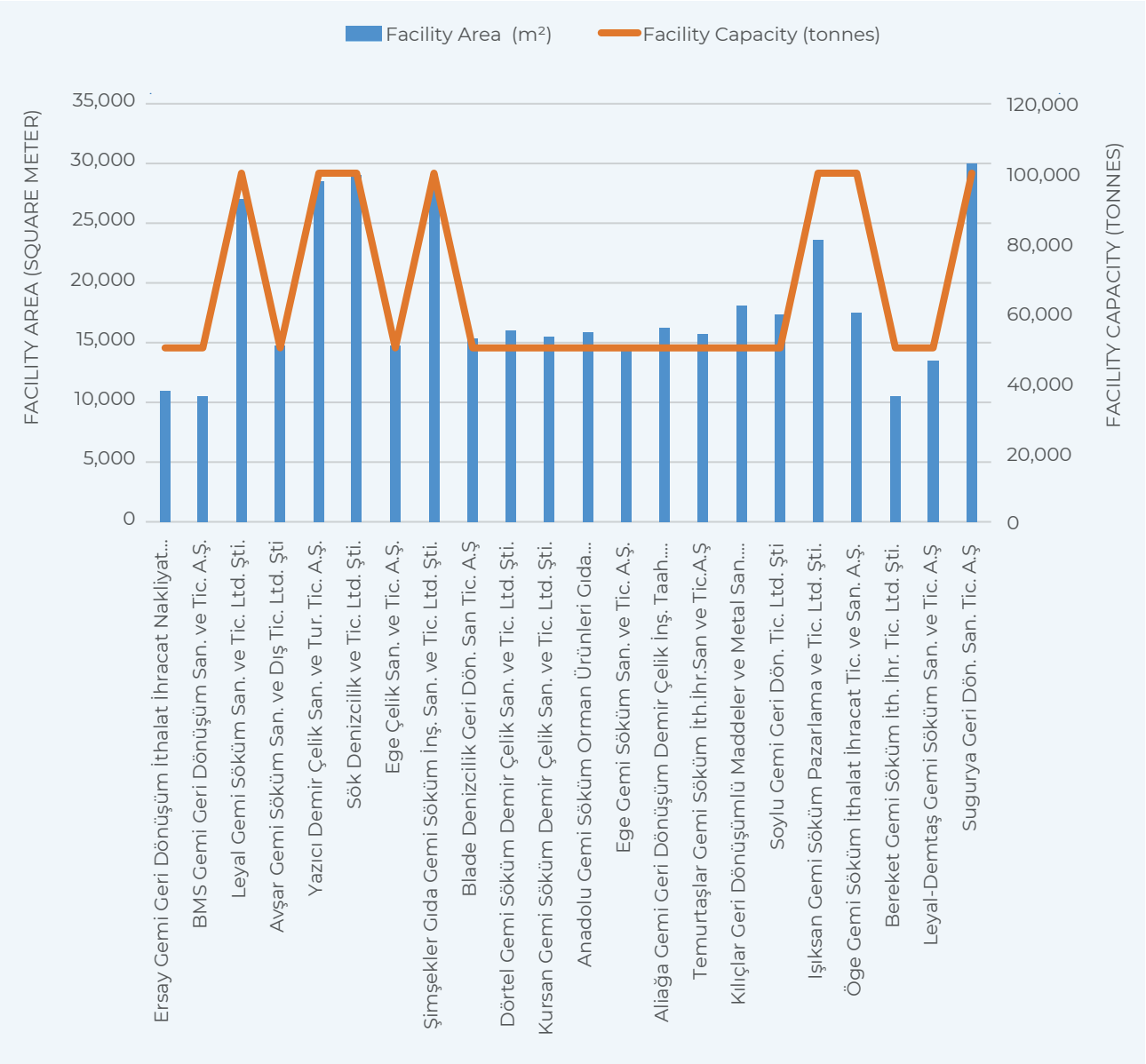
TABLE 2. İzmir Aliağa Ship Recycling Facilities, Areas and Capacities (General Directorate of Shipyards and Coastal Structures, 2021a)

Fac. No	Parcel No	Facility Name / Business	Facility Area (m²)	Facility Capacity (tonnes)
1	1	Ersay Gemi Geri Dönüşüm İthalat İhracat Nakliyat San. ve Tic. A.Ş.	11,000	50,000
2	2	BMS Gemi Geri Dönüşüm San. ve Tic. A.Ş.	10,500	50,000
3	3-4	Leyal Gemi Söküm San. ve Tic. Ltd. Şti.	27,000	100,000
4	5	Avşar Gemi Söküm San. ve Dış Tic. Ltd. Şti	14,800	50,000
5	6-7	Yazıcı Demir Çelik San. ve Tur. Tic. A.Ş.	28,500	100,000
6	8-9	Sök Denizcilik ve Tic. Ltd. Şti.	29,050	100,000
7	10	Ege Çelik San. ve Tic. A.Ş.	14,700	50,000
8	11-12	Şimşekler Gıda Gemi Söküm İnş. San. ve Tic. Ltd. Şti.	28,000	100,000
9	13	Blade Denizcilik Geri Dön. San Tic. A.Ş	15,350	50,000
10	14	Dörtel Gemi Söküm Demir Çelik San. ve Tic. Ltd. Şti.	16,040	50,000
11	15	Kursan Gemi Söküm Demir Çelik San. ve Tic. Ltd. Şti.	15,560	50,000
12	16	Anadolu Gemi Söküm Orman Ürünleri Gıda Turizm Nak. San. ve Tic. Ltd. Şti.	15,840	50,000
13	17	Ege Gemi Söküm San. ve Tic. A.Ş.	14,490	50,000
14	18	Aliağa Gemi Geri Dönüşüm Demir Çelik İnş. Taah. San. ve Tic. Ltd. Şti.	16,310	50,000
15	19	Temurtaşlar Gemi Söküm İth. İhr. San ve Tic.A.Ş	15,730	50,000
16	20	Kılıçlar Geri Dönüşümlü Maddeler ve Metal San. ve Tic. A.Ş	18,180	50,000
17	21	Soylu Gemi Geri Dön. Tic. Ltd. Şti	17,390	50,000
18	22	Işıksan Gemi Söküm Pazarlama ve Tic. Ltd. Şti.	23,680	100,000
19	23	Öge Gemi Söküm İthalat İhracat Tic. ve San. A.Ş.	17,540	100,000
20	24	Bereket Gemi Söküm İth. İhr. Tic. Ltd. Şti.	10,560	50,000
21	25	Leyal-Demtaş Gemi Söküm San. ve Tic. A.Ş	13,490	50,000
22	ABC	Sugurya Geri Dön. San. Tic. A.Ş	30,000	100,000
Total			**403,710**	**1,450,000**

In addition, as shown in Figure 13, it has been observed that Ersay, BMS, Işıksan, Element and Bereket shipbreaking facilities provided more effective facility capacity compared to other facilities.

As of the end of 2020, Türkiye got included in the European Commission Ship Recycling List specified in the European Recycling Regulation, which entered into force in 2018 with a total of 8 companies, namely Leyal, Leyal and Demtaş, Işıksan, Öğe, Ege Çelik, Şimşekler, Sök Denizcilik and Avşar shipbreaking facilities. In 2021, Ege Gemi, Temurtaşlar, Anadolu Gemi, BMS, Aliağa Gemi Geri Donusum, Dörtel, Sugurya, Kılıçlar and Blade Denizcilik. In 2021, Ege Gemi, Temurtaşlar, Anadolu Gemi, BMS, Aliağa Gemi Geri Donusum, Dörtel, Sugurya, Kılıçlar and Blade Denizcilik companies were taken under field inspection by the DNV-GL classification society authorized by the EU commission. It is expected that Türkiye will take place in the EU list with a total of 17 facilities in 2022. Considering that the tonnage of EU flagged ships is around 2 million tons, it is important to enter this list in order to get a share from the market.

FIGURE 13. İzmir Aliağa Ship Recycling Facilities Area and Capacity Comparison

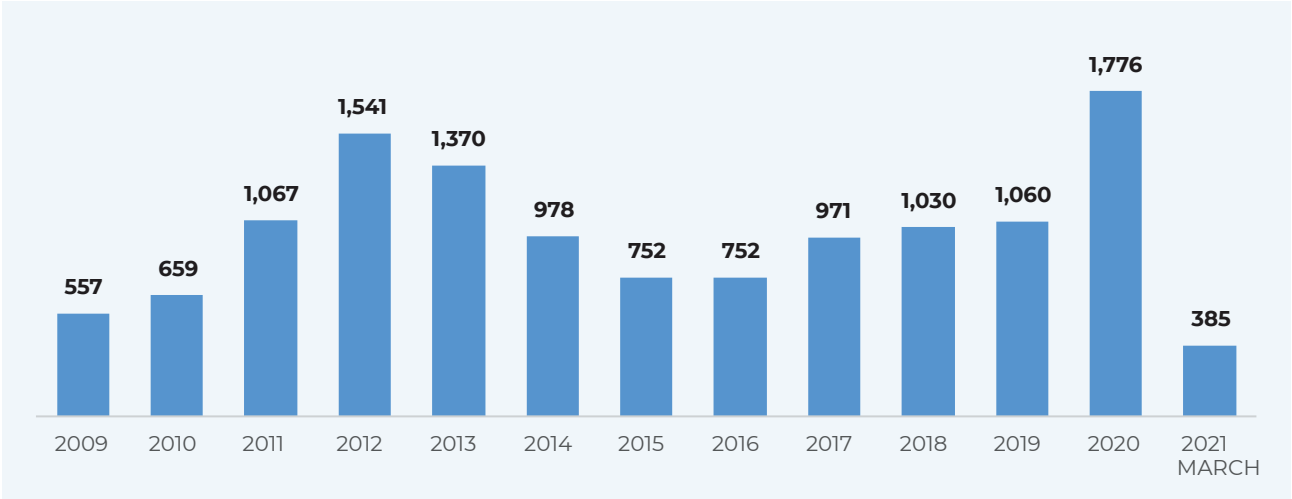


4.2. Recycling Processes Performed in Aliağa Shipbreaking Facilities

There are classifications such as number of ships, ship types, GT, LDT and steel ton weight in the statistical data regarding the operations carried out in İzmir Aliağa SR facilities.

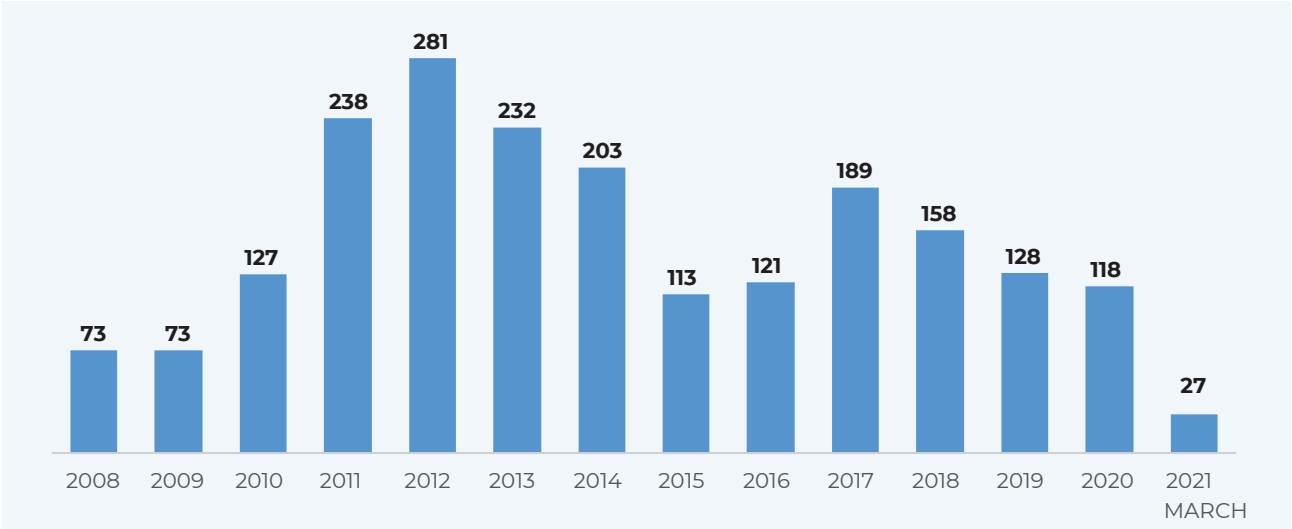
When the ship recycling carried out according to the years is analysed according to tonnage, the total tonnage of the ships subjected to recycling occurs to be 557 thousand GT in 2009, reaching 1,776 million GT in 2020 with an increase of 219% (Figure 14).

FIGURE 14. Ship Tonnage Recycled in Aliağa (General Directorate of Shipyards and Coastal Structures, 2021b)



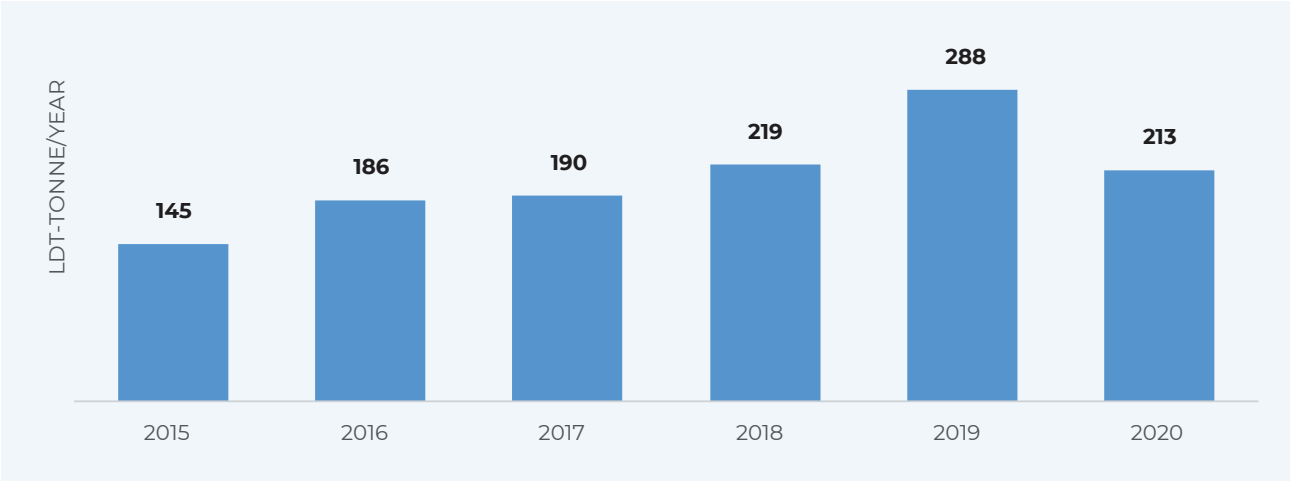
When the change is analysed on a unit basis, it is observed that while 73 ships were dismantled in 2009, this number increased by 62% up to a total of 118 ships as of the year 2020 (Figure 15).

FIGURE 15. Ships Taken for Recycling (General Directorate of Shipyards and Coastal Structures, 2021c)



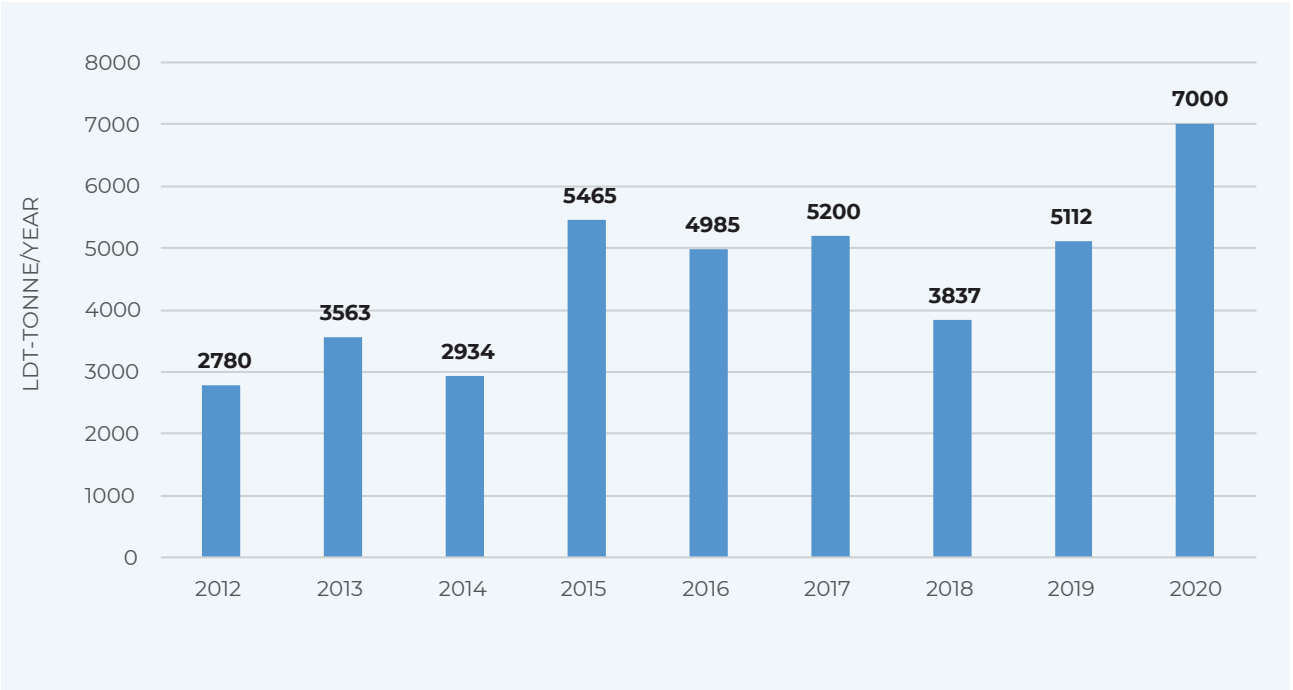
The decline in crude oil prices beginning in 2015 and extending to 2020 caused a decline in oil production. This has accelerated the dismantling and recycling process of oil platforms. Throughout the world, Türkiye has become the preferred country for the recycling of oil platforms. For this reason, the industry has had a serious experience regarding offshore structures as platforms. The LDT-based recycling tonnages of the platforms are shown in Figure 16.

FIGURE 16. Platforms Recycled in Aliağa in Tonnage (GEMİSANDER, 2020a)



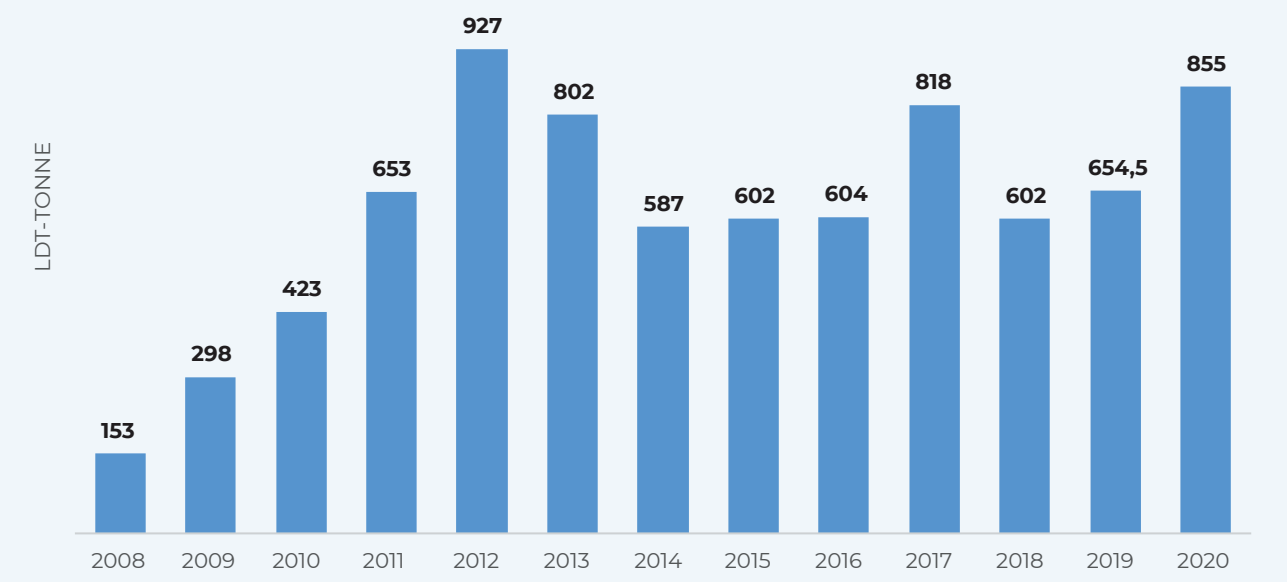
The recycled platform tonnages, given by years in Figure 16, occurred to be 145 thousand LDT in 2015, while this number reached 213 thousand LDT as of 2020. Another increase occurred in the average ship tonnage, with an average tonnage of 2780 LDT in 2012 reaching 7000 LDT in 2020 with an increase rate of 252% (Figure 17).

FIGURE 17. Average Ship Tonnages Received in Aliağa (GEMİSANDER, 2020a)



When the steel weights of the ships accepted for recycling are analysed, it is seen that this steel weight of ships figure that was 153,000 tons in 2008 came with an increase of 559% as of the end of 2020 to reach 855,000 tons (Figure 18).

FIGURE 18. Ship Steel Weights Received in Aliağa (GEMİSANDER, 2020a; İMEAK DTO, Deniz Sektörü Raporu, 2017).



In Figure 19 through Figure 24, the number of ship types dismantled in Aliağa SR Facilities is shown by years. When these statistics are examined, it is seen that mainly platforms, dry cargo ships, passenger ships, Ro-Ro, tankers, tugboats etc., come to the region for dismantling.

As seen in Figure 19, the dry cargo ships happened to have the highest ratio in recycling operations in terms of LDT in 2015. In 2016, most of the dismantling operations took place on platforms, recycling of 186 platforms was followed by the dismantling of 170 dry cargo ships (Figure 20).

FIGURE 19. Types of Ships Received in Aliağa in 2015 (İMEAK DTO, 2016)

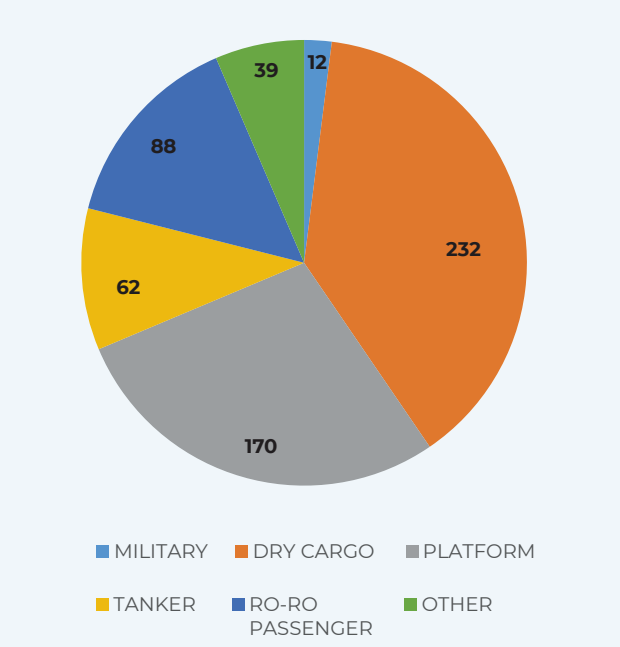
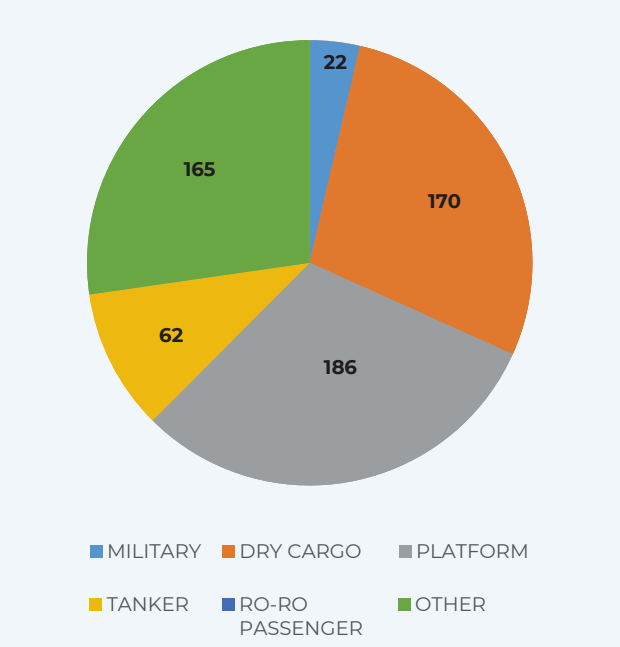
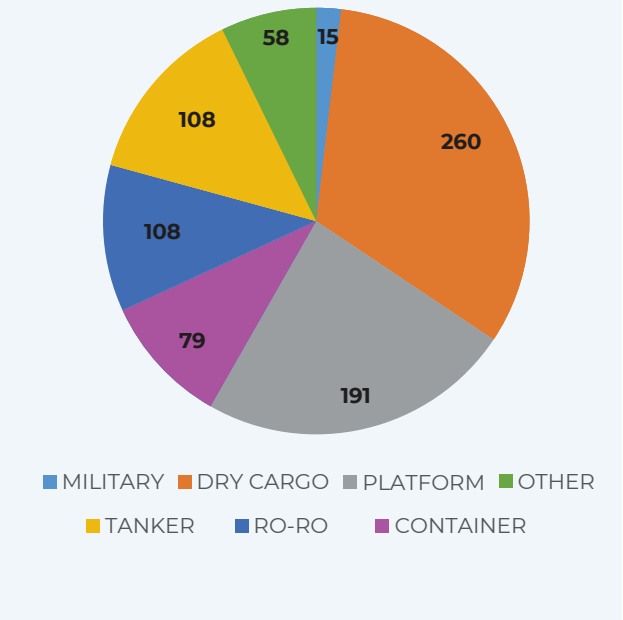


FIGURE 20. Types of Ships Received in Aliağa in 2016 (GEMİSANDER, 2016)



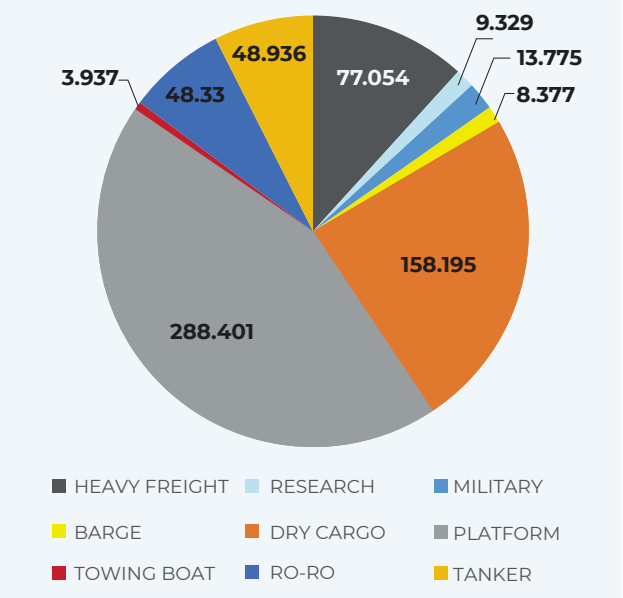
Through the examination of the year 2017 data, it is seen that most of the dismantling processes were realized on platforms. Recycling of 191 platforms was followed by 260 dry cargo ship and 108 tanker dismantling operations (Figure 21).

FIGURE 21. Types of Ships Received in Aliağa in 2017 (GEMİSANDER, 2017)



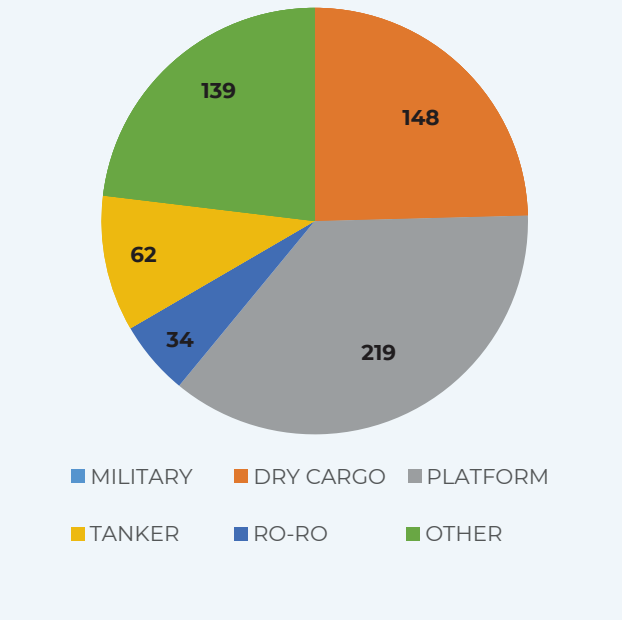
In 2019, 288 thousand LDT equivalent platform and 158 thousand LDT equivalent dry cargo ship dismantling operations were realized. (Figure 23).

FIGURE 23. Types of Ships Received in Aliağa in 2019 (GEMİSANDER, 2019)



It is observed that platform dismantling operations has the highest number in 2018. 219 platform recycling operations were followed by 148 dry cargo ship dismantling operations (Figure 22).

FIGURE 22. Types of Ships Received in Aliağa in 2017 (GEMİSANDER, 2018)



In 2020, 213 platforms were dismantled, followed by 162 passenger ships (Figure 24).

FIGURE 24. Types of Ships Received in Aliağa in 2020 (GEMİSANDER, 2020a)

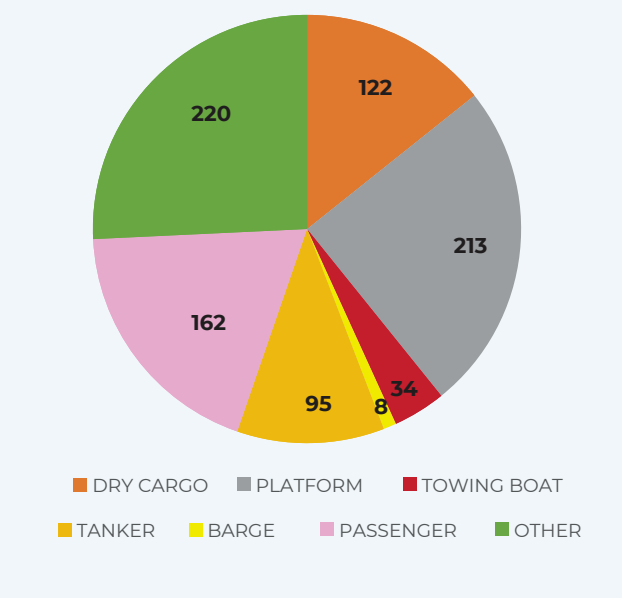


Table 3 indicates ships with 300 GT and above in the Turkish Maritime Fleet. Within the overall 1,103,156 GT and 1,909,169 DWT in the fleet, bulk carriers come first. It is observed that the highest number belongs to the dry cargo ships among all types registered in the Turkish Merchant Fleet. There are 176 dry cargo ships in the fleet as a total within the Turkish National Ship Registry (MGS) and the Turkish International Ship Registry (TUGS).

In Table 4, ships of 300 GT and above are examined according to their DWT and age distribution. A total of 1097 ships are registered in this group, and ships aged 20 and over make up 33.2% of the total fleet.

In Table 5, the number of ships of 1000 GT and above in the Turkish Maritime Fleet are examined with respect to their DWT and GT values and their average age. It is observed that there are 516 ships in the fleet and the average age of these ships is 22.76. The average age of the dry cargo ships constituting 27.3% of the fleet is 27, while that of the bulk carriers constituting 10.9% of the fleet is 19, the chemical tankers constituting 10.5% of the fleet is 18 and the container ships constituting 9.5% is 15.

In the light of the available data, it has been determined that there is a need for the recycling of ships that have completed their economic life for rejuvenating the Turkish Merchant Fleet.

TABLE 3. Turkish Merchant Fleet (300 GT and above, 31.12.2019) (İMEAK, 2020a).

Ship Type	NUMBER				DWT				GRT			
	MGS	TUGS	Total	%	MGS	TUGS	Total	%	MGS	TUGS	Total	%
Dry Cargo Ship	26	150	176	16.05	65,547	686,357	751,904	11.5	42,001	441,465	483,466	8.64
Bulk Carrier Ship	5	41	46	4.19	116,655	1,792,514	1,909,169	29.15	71,927	1,031,256	1,103,183	19.71
Container Ship	5	42	47	4.28	156,278	858,308	1,014,586	15.51	123,464	686,054	809,518	14.47
Dry Cargo - Container	1	8	9	0.82	2,356	55,631	57,987	0.89	1,720	37,113	38,833	0.69
Chemical Tanker	2	54	56	5.1	9,497	603,633	613,130	9.37	6,441	392,837	399,278	7.14
LPG Tanker	0	5	5	0.46	0	27,804	27,804	0.43	0	25,574	25,574	0.46
Asphalt Tanker	1	3	4	0.36	2,770	54,850	57,620	0.88	1,900	43,630	45,530	0.81
Inland Vessel	2	2	4	0.36	1,050	1,627	2,677	0.04	753	861	1,614	0.03
Ro-Ro, Ferry Y	0	12	12	1.09	0	135,903	135,903	2.08	0	308,947	308,947	5.52
Ro-Ro Ferry	12	20	32	2.92	2,225	36,899	39,124	0.6	34,015	68,883	102,898	1.84

Ship Type	NUMBER				DWT				GRT			
	MGS	TUGS	Total	%	MGS	TUGS	Total	%	MGS	TUGS	Total	%
Ferry	2	48	50	4.56	2,314	24,485	26,799	0.41	1,968	51,271	53,239	0.95
Train Ferry	6	0	6	0.55	2,960	0	2,960	0.05	9,835	0	9,835	0.18
FPassenger / Passenger Cargo	24	102	126	11.49	5,476	38,032	43,508	0.67	25,885	74,933	100,818	1.8
Fishing Boat	71	6	77	7.02	3,489	4,408	7,897	0.12	33,614	11,244	44,858	0.8
Scientific Research Ship	6	7	13	1.19	801	3,580	4,381	0.07	3,049	34,421	37,470	0.67
Public Ferry	3	20	23	2.1	551	1,796	2,347	0.04	1,544	11,482	13,026	0.23
Fast Ferry	1	5	6	0.55	230	1,489	1,719	0.03	901	6,470	7,371	0.13
Public Ferry – land vhc.	3	15	18	1.64	0	309	309	0	1,134	5,987	7,121	0.13
Motor Boat	30	66	96	8.75	1,302	563	1,865	0.03	14,060	26,533	40,593	0.73
Tugboat	70	58	128	11.67	38,459	154,512	192,971	2.95	95,795	355,138	450,933	8.06
Service Ships	13	56	69	6.29	24,239	1,456,998	1,481,237	22.65	14,180	784,000	798,180	14.26
Petroleum Tanker	0	1	1	0.09	0	6,266	6,266	0.1	0	15,195	15,195	0.27
Train Ferry / RoRo	1	9	10	0.91	11,978	127,076	139,054	2.13	32,770	342,302	375,072	6.7
Dry Cargo / Ro-Ro	1	0	1	0.09	746	0	746	0.01	399	0	399	0.01
Marine Vehicles	60	22	82	7.47	10,455	8,415	18,870	0.29	64,313	258,588	322,901	5.77
Grand TOTAL	**345**	**752**	**1.097**	**100**	**459,378**	**6,081,455**	**6,540,833**	**100**	**581,668**	**5,014,184**	**5,595,852**	**100**

TABLE 4. Türkiye Merchant Fleet Distribution by Tonnage and Age Group (300 GT and above, 31.12.2019) (İMEAK, 2020a)

Tonnage	0-9 Years			10-19 Years			20-29 Years			30 Years and above			Total	
	#	DWT	%	#	DWT	%	#	DWT	%	#	DWT	%	#	DWT
0 - 149	169	0	0	114	296	13.43	73	1,035	47	147	872	39.57	503	2,203
150 - 1499	15	11,398	8.23	23	17,886	12.91	29	20,259	14.63	110	88,982	64.24	177	138,524
1500 - 5999	17	53,433	7.7	41	148,531	21.41	44	155,291	22.38	109	336,482	48.5	211	693,738
6000 - 9999	3	22,728	5.34	20	145,935	34.29	18	139,566	32.8	16	117,340	27.57	57	425,569
10000 - 34999	20	351,069	18.45	48	892,059	46.89	19	328,931	17.29	15	330,516	17.37	102	1,902,575
35000 - 52999	6	249,518	23.61	9	391,941	37.09	9	415,179	39.29	0	0	0	24	1,056,638
53000 - 79999	1	61,619	8.88	9	559,927	80.71	1	72,171	10.4	0	0	0	11	693,717
80000 - 119999	0	0	0	3	247,564	100	0		0	0	0	0	3	247,564
120000 +	5	764,903	55.42	3	450,543	32.64	1	164,859	11.94	0	0	0	9	1,380,305
Grand Total	**236**	**1,514,668**	**23.16**	**270**	**2,854,680**	**43.64**	**194**	**1,297,292**	**19.83**	**397**	**874,191**	**13.37**	**1.097**	**6,540,831**

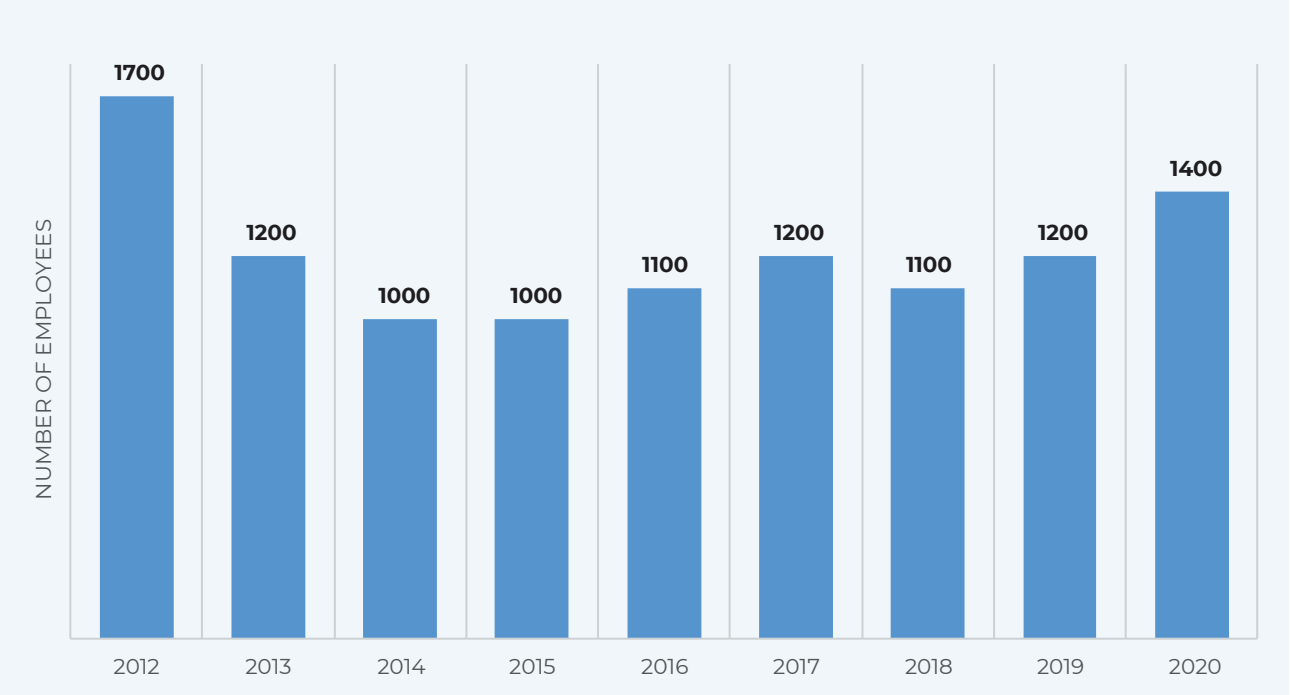
TABLE 5. Türkiye Merchant Fleet (1000 GT and above, 31.12.2019) (İMEAK, 2020b)

SHIP TYPE	Number	Tonnage (DWT)	Tonnage (GT)	Age average
Dry Cargo Ship	141	739,404	482,437	27
Bulk Carrier Ship	56	247,1477	1,423,014	19
Container Ship	49	1,041,029	832,387	15
Dry Cargo - Container	10	62,835	42,230	22
Chemical Tanker	54	53,1182	343,143	18
LPG Tanker	5	27,804	25,574	22
Asphalt Tanker	4	57,620	45,530	12

SHIP TYPE	Number	Tonnage (DWT)	Tonnage (GT)	Age average
Ro-Ro Ship	18	195,680	460,099	17
Ro-Ro, Ferry - Passenger	17	27,790	86,473	24
Ferry	29	22,186	56,571	23
Train Ferry	6	2,960	9,834	46
Passenger / Passenger Cargo Ship	9	7,227	26,356	25
Fishing Boat	2	569	3,941	23
Scientific Research Ship	6	778	35,832	22
Public Ferry	1	0	1,043	67
Public Ferry - land vhc.	6	1,974	7,547	26
Tugboat	1	0	1,565	35
Service Ships	44	86,454	380,593	31
Petroleum Tanker	22	1,423,480	760,986	16
Train Ferry / Ro-Ro	1	6,266	15,195	33
Dry Cargo / Ro-Ro	6	87,637	251,232	6
Marine Vehicles	29	13,686	288,488	24
Grand Total	516	6,815,040	5,580,071	22,76

A total of 1700 people are employed while 22 shipbreaking facilities in İzmir Aliağa are functioning at their full capacity of 1,000,000 LDT. When the number of personnel working in the region by years is examined, it is observed that this capacity has been achieved in 2012 (Figure 25). It is seen that the number of personnel employed between 2012-2020 varies between 1000-1700. In 2014, as a reflection of the global economic crisis, the number of employment decreased to 1000s. The number of employees can reach 10,000 with the inclusion of the employment by contractors, subcontractors, transporters, other ancillary services and personnel working in the sub-industry, for which shipbreaking companies deal in business activities. (İMEAK DTO, 2016).

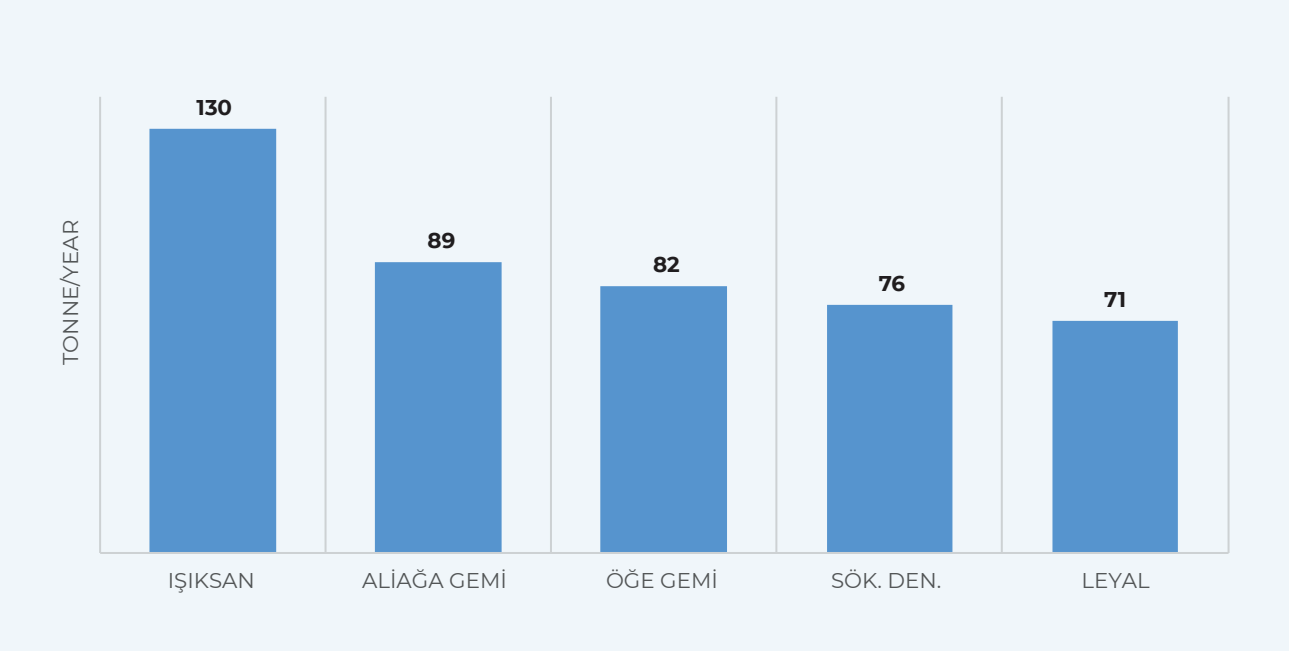
FIGURE 25. Number of Employees in Aliağa Recycling Sector (GEMİSANDER, 2020a)



Işıksan, Aliağa Gemi, Öğe Gemi, Sök Denizcilik, and Leyal come up as the top 5 shipbreaking facilities in Aliağa when the 22 shipbreaking facilities that are now operational are reviewed (Figure 26).

Işıksan realized 130 tons equivalent of SR activities in 2020. This amount corresponds to 15% of the total SR amount realized by 22 facilities in 2020.

FIGURE 26. Companies by Ship Recycling Import Tonnages in 2020 (Thousand LDT-Tonne/Year) (GEMİSANDER, 2020a)



4.3. Waste Management in Aliağa Recycling Facilities

The ship curb weight of between 5,000 and 40,000 tons when scrapped consists 95% of 10 to 100 tons of arsenic, zinc, lead, organotin, cadmium and chrome-plated steel. Ships may also contain hazardous waste containing PCBs. Tankers, on the other hand, can contain approximately 1,000 cubic meters of residual oil (Ministry of Environment, Urbanization and Climate Change, 2018).

The main impact of shipbreaking facilities on the environment is the environmental risks that will arise if the waste management of hazardous wastes is not performed correctly. Hazardous substances within ship's structure and equipment are as listed below;

- Asbestos
- Polychlorinated biphenyls (PCBs)
- Ozone depleting substances (ODSs)
- Anti-pollution compounds and systems
- Cadmium and cadmium compounds
- Hexavalent chromium and hexavalent chromium compounds
- Lead and lead compounds
- Mercury and mercury compounds
- Polybrominated biphenyls (PBBs)
- Polibrominated diphenyl ethers (PBDEs)
- Polychlorinated naphthalenes (PCNs)
- Radioactive materials
- Certain short chain chlorinated paraffins

During shipbreaking operations, various wastes are generated in the forms of waste oils (sludge), bilge and/or wastewater generated by the treatment systems attached to the machines, cloths contaminated by oil or chemicals, ballast water, fuel tank residues and dry tank residues. Ship operating wastes that may occur during ship breaking are raw and treated domestic wastewater, medical/infectious wastes, greasy liquid cargo residues, greasy solid cargo tank residues and cargo residues (Ministry of Environment, Urbanization and Climate Change, 2018). Attention should be paid to environmental problems that may be potentially caused by shipbreaking facilities such as release of hazardous substances to the seabed, water and air, and noise/vibration.

In Aliağa District, the waste management-tracking system established by the Ministry of Environment, Urbanization and Climate Change in 2007 is being implemented. In the Waste Management Centre Unit operating under GEMİSANDER, the activities of detecting/temporary storage, disposal and reporting of existing wastes from scrap ships are carried out from the centre. In accordance with the regulation issued by the Ministry of Environment, Urbanization and Climate Change, SR facilities have begun to undertake the task of individually fulfilling their waste producer obligations. In this context, at the beginning of 2021, seven SR companies obtained temporary storage permits and started individual waste management practices.

In addition to the recovery of minerals, scrap material and equipment during SR, their wastes should also be utilized and unnecessary natural resource consumption should be prevented by means of recycling such wastes. In recent years, it has been determined that there are no hazardous chemicals in the structural elements of international hazardous substance ships arriving at Aliağa SR facilities, and those that do occur to be below the international hazard threshold values. This fact shows that ships have started to be purified from asbestos and other hazardous substances over the (GEMİSANDER, 2016; GEMİSANDER, 2017; GEMİSANDER, 2018; GEMİSANDER, 2019; GEMİSANDER, 2020a; GEMİSANDER, 2020b).

81% of 15829 tons of waste in 2017 and 90% of 17469

tons of waste in 2019 were recovered in the facilities (GEMİSANDER, 2017; GEMİSANDER, 2019) This increase in waste recovery rate in two years shows that there is experience, knowledge and awareness within the sector.

GEMİSANDER, which has been responsible for the management of waste generated in ship recycling until 2021, has passed this responsibility onto the facilities.

FIGURE 27. Aliağa Ship Recycling Facilities Waste recovery-disposal rates in 2017 (GEMİSANDER, 2017).

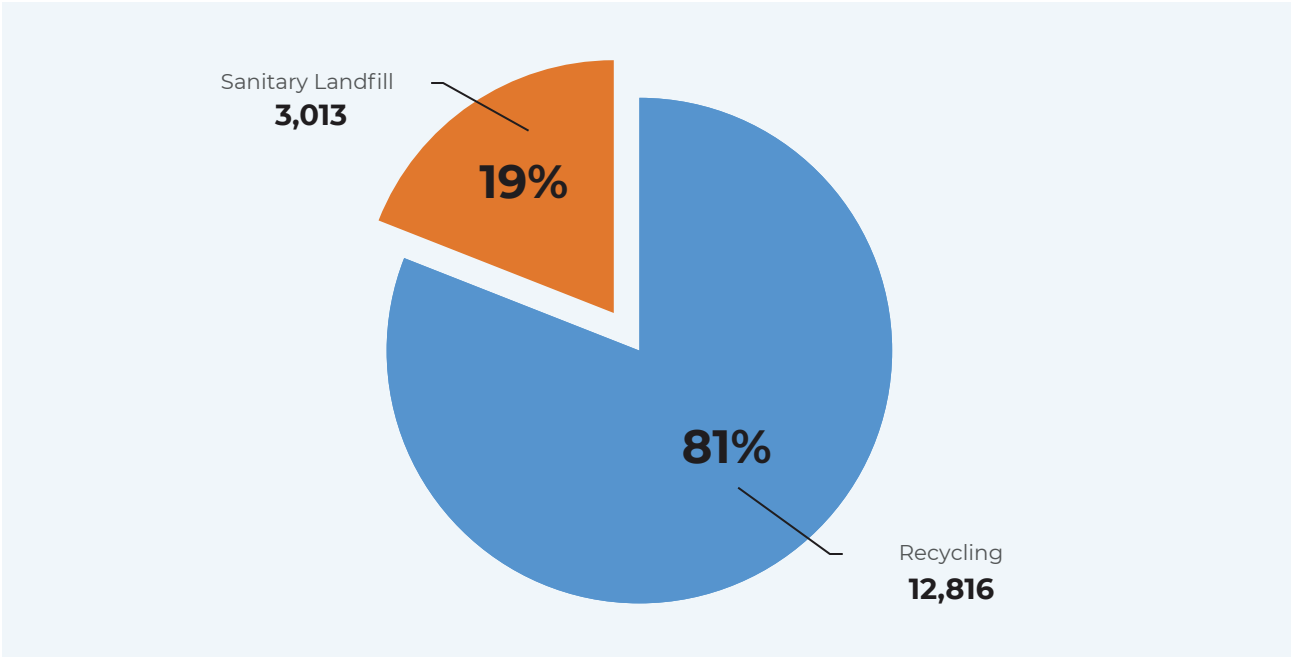
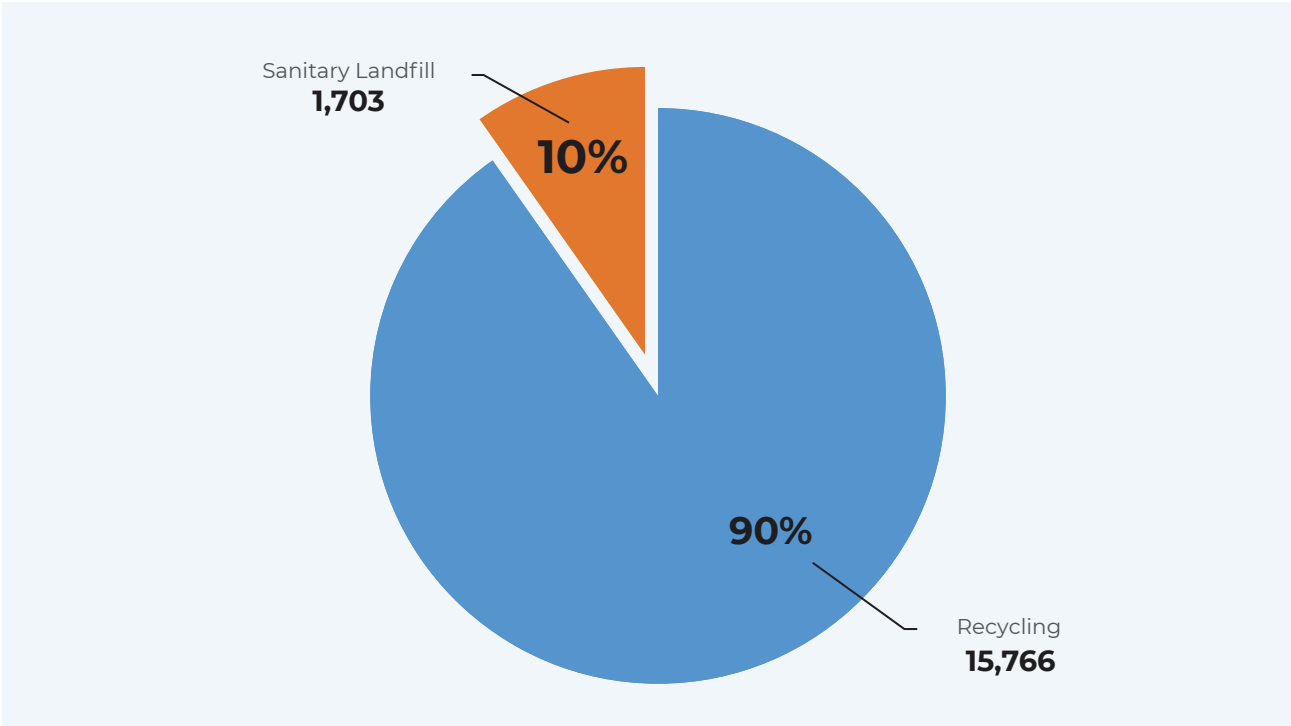


FIGURE 28. Aliağa Ship Recycling Facilities Waste recovery-disposal rates in 2019 (GEMİSANDER, 2019)



In Figure 29 and Figure 30, all sequential operations to be implemented on a ship to be dismantled beginning from its arrival at the anchorage in the shipbreaking zone are shown for Pre-Notification Merchant Ships and Conditional Notification.

FIGURE 29. Ship Recycling Sequential Operations at Aliağa Ship Recycling Facilities (Pre-Notification Merchant Ships) (GEMİSANDER, 2021)

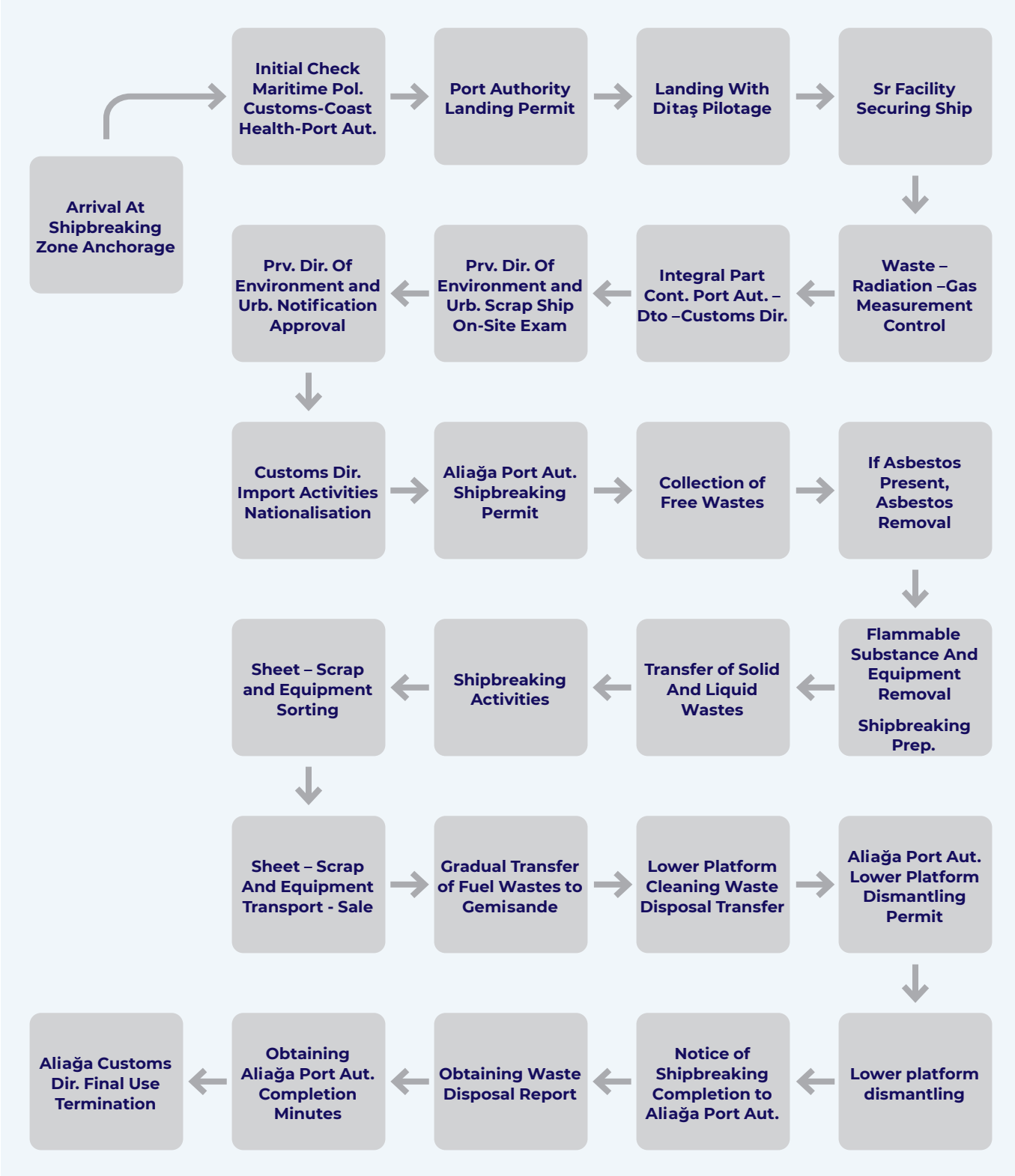
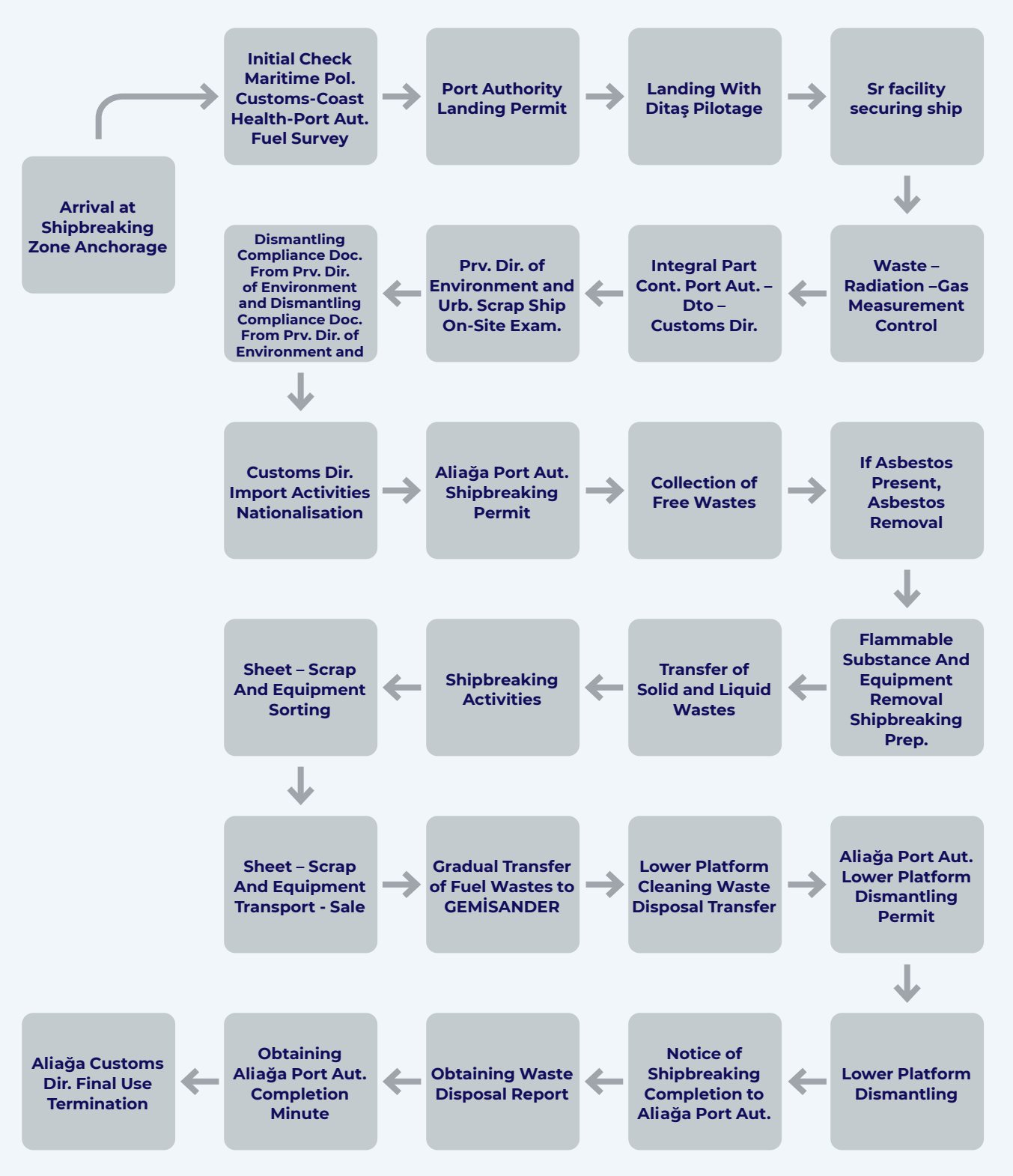


FIGURE 30. Ship Recycling Sequential Operations at Aliağa Ship Recycling Facilities (Conditional Notification) (GEMİSANDER, 2021). (Notification and import procedures are not applied for Turkish flagged vessels)



4.4. Conclusions and Evaluation

The Turkish SR sector continues its activities in İzmir Aliağa District. 22 facilities in the region carry out shipbreaking operations. The European Recycling Regulation, which obliges EU flagged ships to be able to carry out shipbreaking only at facilities on the EU Ship Recycling list, has provided Türkiye with an advantage. From Türkiye, which is included in the EU Commission Ship Recycling List with 8 facilities, 9 more facilities have already made the necessary applications to be included in the EU list.

Aliağa SR facilities provide a hub where all types of ships that have completed their economic life (dry cargo, tanker, platform, military ship, RO-RO, passenger, container and other auxiliary ships) are recycled and recovered as steel raw material. In 2020, 118 ships were dismantled and 855 thousand LDT was processed.

When the number of ships of 1000 GT and above in the Turkish Maritime Fleet is examined, it is observed that there are 516 ships and the average age of these ships is 22.76. The average age of dry cargo ships constituting 27.3% of the fleet is 27, the average age of bulk carriers constituting 10.9% is 19, the average age of chemical tankers constituting 10.5% is 18 and the average age of container ships constituting 9.5% is 15. Through examination of the available data, it has been observed that a serious SR should be realized in order to rejuvenate the Turkish Merchant Marine Fleet in the coming days.

In İzmir Aliağa, the number of employees can reach 10,000 with the inclusion of personnel working at SR activities and within the bodies of the contractors, subcontractors, transporters and other ancillary services along with sub-industry personnel employed by the facilities.

In addition to the recovery of minerals, scrap material and equipment during SR, their wastes should also be utilized and unnecessary natural resource consumption should be prevented by means of recycling such wastes. 81% of 15829 tons of waste in 2017 and 90% of 17469 tons of waste in 2019 were recovered in the facilities. This shows that there is experience, knowledge and awareness in the sector on waste recycling as well.

As Covid-19 affected many industry branches throughout the world, this crisis has had impacts in the fields of shipbuilding, maritime industry, maritime transportation etc., as in many sectors in Türkiye. The SR industry is one of the sectors that turned this pandemic into an opportunity. Especially due to the interruption in cruise ship voyages, ship owners have decided to sell their ships and send them for recycling. This situation provided both experience in handling larger tonnage vessels and a significant foreign currency return for Aliağa.

CHAPTER 5.

Risks in the Ship Recycling Industry

Risky circumstances could occur at several points when the ship is being recycled. These risks have the potential to impact people, the environment, and national economies. It is imperative that the industry fix the issues related to occupational safety during the ship recycling process such as worker conditions, management of the hazardous items carried by the ship being converted, and environmental repercussions of the recycling process. On the other hand, it is important to consider changes in the iron and steel industry as well as trends in the domestic and international markets.

SR activities realized in Bangladesh, India and Pakistan accounts for almost 83% of the global total. Because there are so few safety precautions in SR activities in underdeveloped countries, the accident rates are higher. It is crucial in this industry to follow the international regulations set up to safeguard against negative outcomes. However, it will take time for developing nations to strictly enforce such regulations.

5.1. Hazardous Goods Carried by Ships and Related Environmental Risks

The scope of the environmental risks that arise during the SR varies according to the place of shipbreaking, the type of ship, the load carried by the ship and the materials used during its construction. Shipbreaking operations on beaches and piers pose more environmental risks than activities carried out in dry-docks.

There are various amounts of toxic substances in ships that have completed their operational life and will be dismantled. These substances need to be found, identified, removed and disposed of properly.

Asbestos is one of the most common and most hazardous substances found on ships. It has been used in the past, especially in machine rooms, for its thermal insulation and fire resistant properties. Asbestos found trapped between steel plates on walls or doors breaks down into fine fibres that, when removed, remain suspended in the air for a long time. When inhaled, the fibres can cause fatal diseases such as lung cancer, mesothelioma and asbestosis, the symptoms of which have not been evident for many years. Asbestos fibres can also be carried through workers' clothing and infest other people with whom they live. Special training for personnel, protective equipment and monitoring and decontamination facilities are required (NGO, 2021a).

Heavy metals and heavy metal-containing compounds such as lead, mercury, cadmium, zinc, lead and copper, paints, coatings, insulation, batteries and electrical compounds are also found in recycled ships. These heavy metals can cause health problems such as learning difficulties, mental retardation, hearing and vision loss etc.

Recycled ships contain significantly hazardous substances such as toxic oils, fuels, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, tributyltin etc. In addition, the discharge of ships' bilge and ballast waters into the ocean also endanger the local ecosystem and human health.

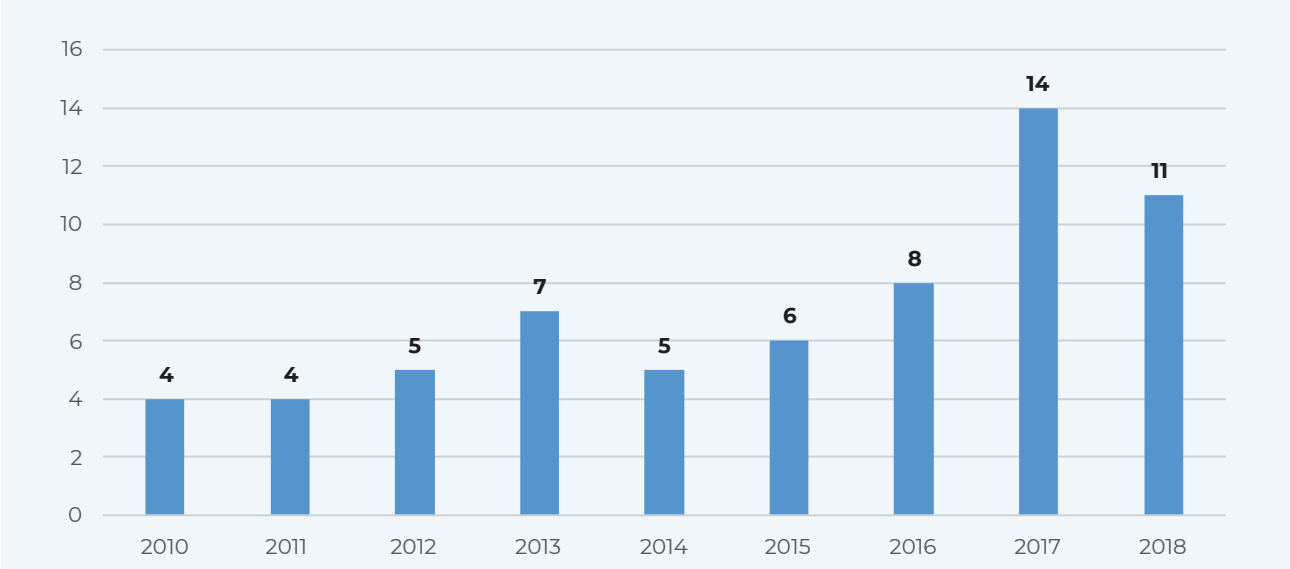
5.2. Occupational Accident Risks

The two main risk factors encountered during worker activities in the SR industry occur to be the insufficient level of occupational safety and the working conditions. There are different occupational accident risk groups such as falling from heights, fire, explosion, object falling, jamming, cable breakage etc. in the sector. The sector being a heavy industry branch, limitations in dismantling times, legislation conditions and procedures being applied incomplete or not at all taken seriously, bad working conditions etc. issues have the potential to harm occupational safety.

NGO Shipbreaking Platform (NGO) officially publishes quarterly reports of shipbreaking accidents in South Asian countries. In addition, NGO also follows the accidents in Türkiye. The EU Commission is responsible for ensuring that all EU-listed shipyards operate in accordance with the requirements of the SR regulation. In order to understand whether the recycling facilities in Aliağa actually operate in accordance with the relevant regulation, the EU commission performs the necessary actions and may remove any non-compliant company from the EU list if necessary. For this reason, Aliağa SR facilities have to be careful against possible threats in order not to lose the advantage of recycling ships from EU countries, which is provided by being on the EU list.

When the accidents between 1985-2003 across 15 SR facilities in Aliağa zone were examined, it was observed that 29 workers lost their lives in 23 occupational accidents. In addition, among the accidents between 1985-2003, there were accidents resulting in various hand, arm injuries and fractures in 80 workers, foot and leg fractures and injuries in 91 workers, various body fractures in 26 workers, head fractures and injuries in 35 workers, and various burns in 31 workers. ((T.R. Ministry of Labor and Social Security, 2005; (T.R. Ministry of Labor and Social Security, 2007).

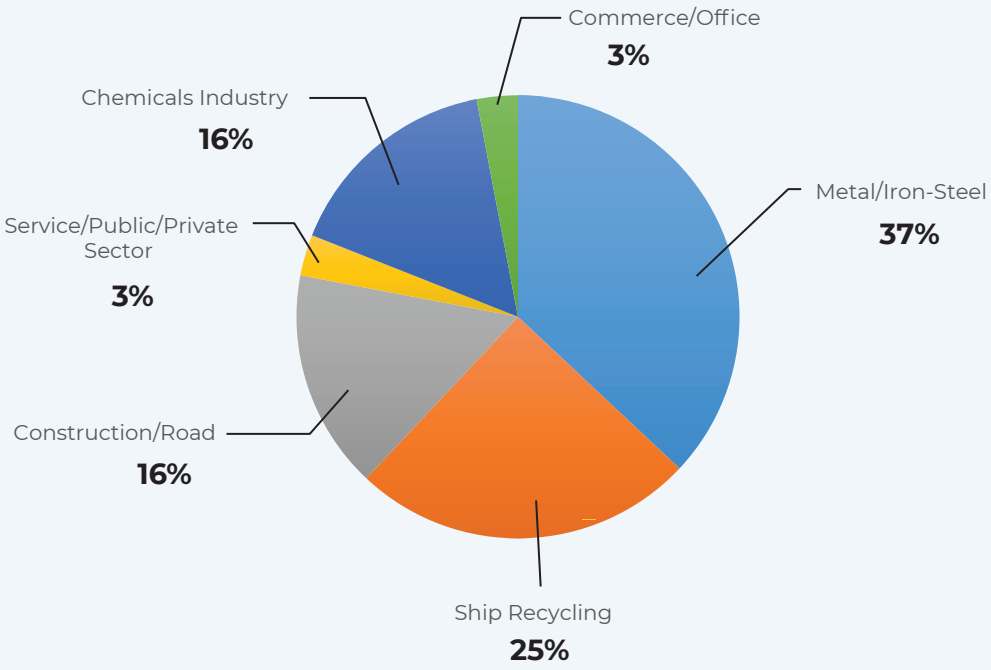
FIGURE 31. Fatal Work Accidents in Aliağa District/2010-2018 (İSGARD, 2019)



64 fatal occupational accidents that occurred in different business lines in Aliağa District between 2010 and 2018 are shown in Figure 31. The highest number of fatal occupational accidents occurred in 2017, when a total of 14 workers lost their lives.

Figure 32 shows the distribution of fatal occupational accidents by sectors. It is observed that 25% of the fatal occupational accidents (16 worker casualties) occurred in the SR sector (İSGARD, 2019).

FIGURE 32. 2010-2018 Fatal Occupational Accident Rates in Aliağa District by Sector (İSGARD, 2019)



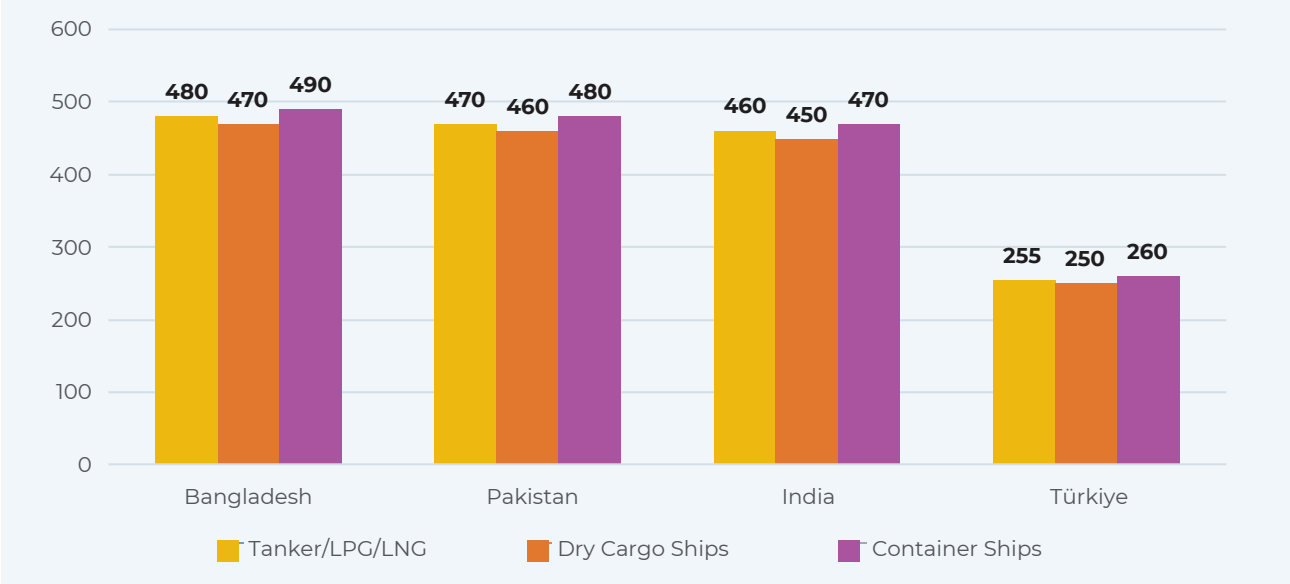
5.3. Low Scrap Prices

Compared to the countries that have a significant share in the SR industry, the low scrap prices in Türkiye constitute a risk for the industry. Figure 33 and Table 6 show the values appraised for different ship types by the 4 countries performing the highest SR throughout the world.

TABLE 6. Shipbreaking Price Comparison (Go Shipping and Management Inc, 2021)

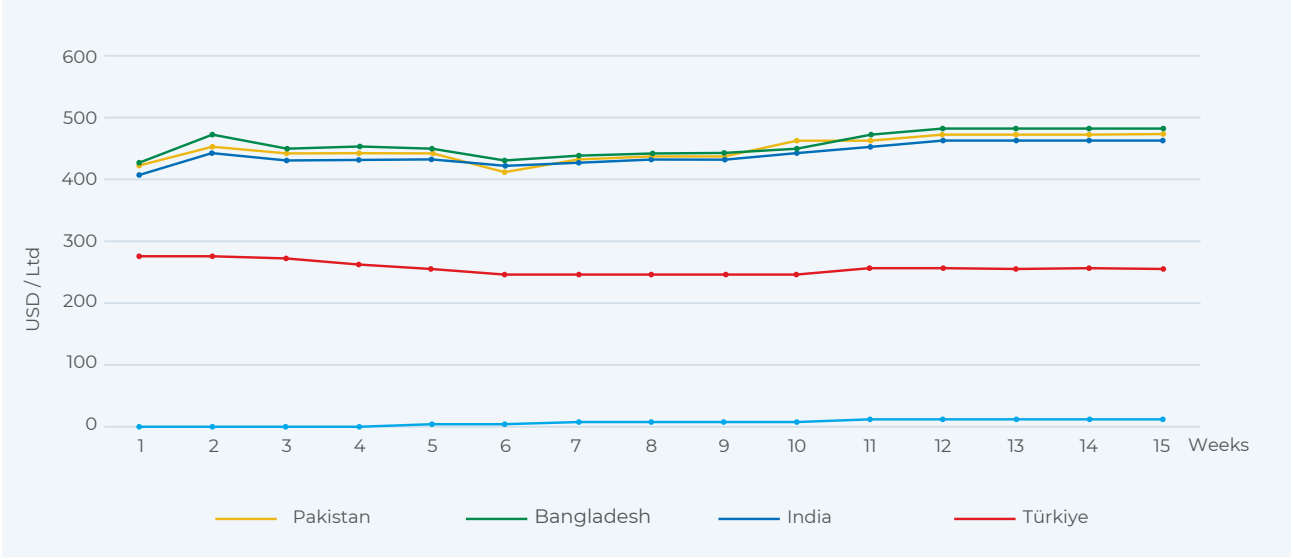
	Tanker/LPG/LNG	Dry Cargo Ships	Container Ships
Bangladesh	475-485	465-475	485-495
Pakistan	465-475	455-465	475-485
India	455-465	445-455	465-475
Türkiye	250-260	245-255	255-265

FIGURE 33. Shipbreaking Price Comparison (Go Shipping and Management Inc, 2021)



The prices paid for each SR per LDT in Bangladesh, Pakistan, and India vary by 20 USD, however Türkiye pays 200–230 USD less per LDT than these three South Asian nations. The desire of the South Asian SR sector to buy scrap ships at a high price is a very alluring offer for ship owners, and thus, hazards in terms of the environment and human health arise as a cost of shipbreaking in underdeveloped countries that do not respect such rules. Figure 34 compares the weekly shipbreaking prices for the aforementioned four countries in 2021.

FIGURE 34. 2021 Weekly Dismantling Price Comparison (Go Shipping and Management Inc, 2021)



The indicated price levels vary depending on the age, dimensions and type of the ship. Here, it is observed that the three South Asian countries (Bangladesh, India and Pakistan) pay 400-500 USD per LDT, while the SR Facilities in Türkiye Aliağa pay less than 300 USD per LDT.

Figure 35 shows the scrap prices per ton at Aliağa SR facilities between 2016 and 2020. The maximum scrap price occurred to be found as 255 USD/tonne in 2016, 346 USD/tonne in 2017, 368 USD/tonne in 2018, 340 USD/tonne in 2019 and 455 USD/tonne in 2020.

FIGURE 35. 2016-2020 Scrap Prices (GEMİSANDER, 2016)

	January	February	March	April	May	June	July	August	September	October	November	December
2016	180	190	230	240	225	215	210	225	225	235	250	255
2017	245	237	268	265	274	281	301	346	330	300	312	343
2018	368	358	368	355	345	347	345	320	325	330	335	290
2019	305	340	325	315	295	295	295	290	238	235	275	300
2020	300					250						455

Owners of ships or fleets usually want to have their vessels dismantled at the facility offering the best rates for scrap. It is preferred that the ship is dismantled in a close facility where it can go with its propulsion system, which eliminates the costs of towing the ship with the tugboat. Figure 36 and Figure 37 illustrate the process flowcharts of the shipbreaking decision and the ship supply-demand balance, respectively. (TÜRKTERMAP, 2007).

FIGURE 36. Shipbreaking decision (TÜRKTERMAP, 2007)

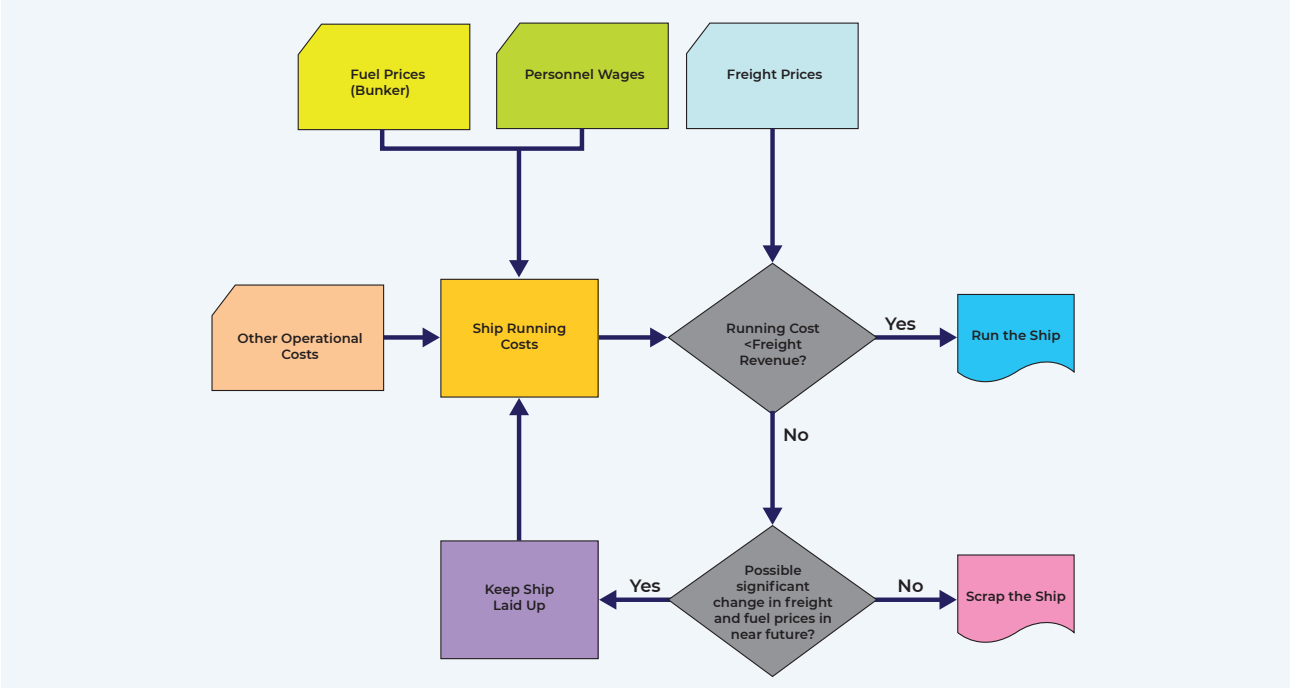
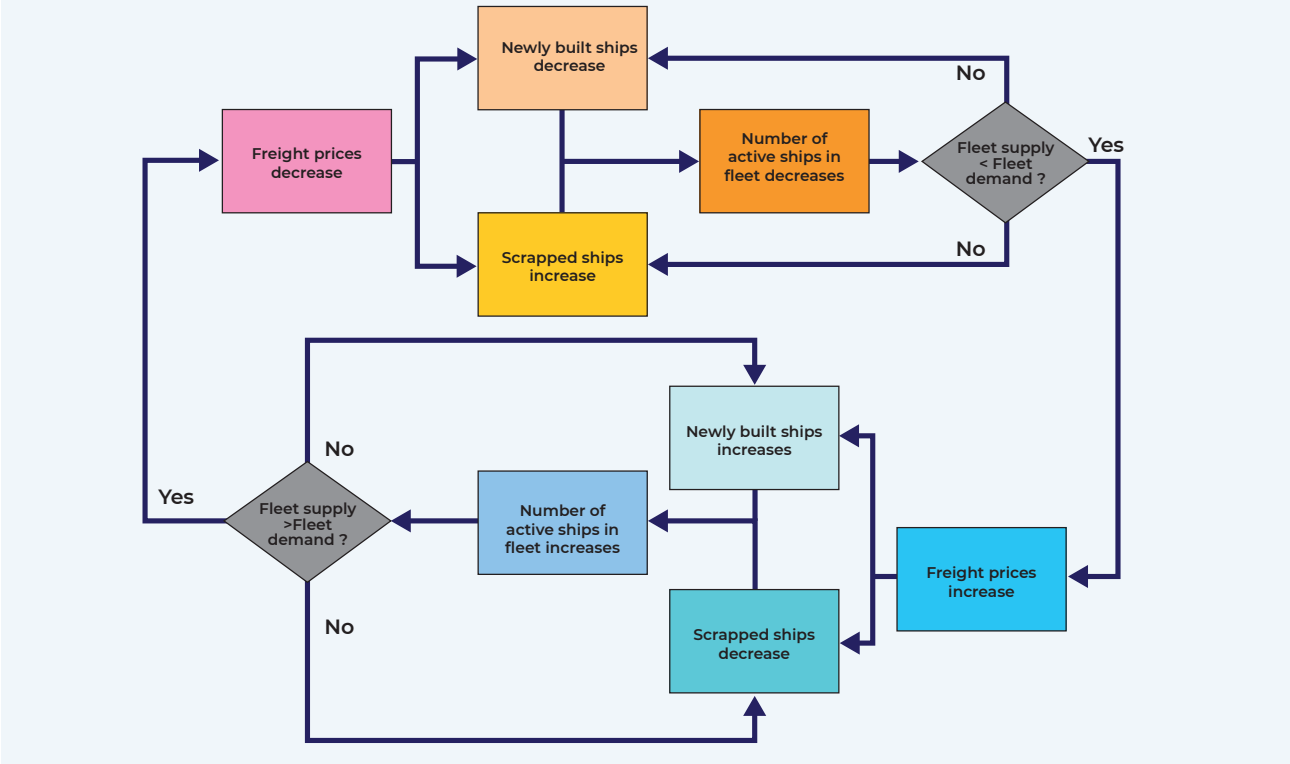


FIGURE 37. Ship supply-demand balance (TÜRKTERMAP, 2007)



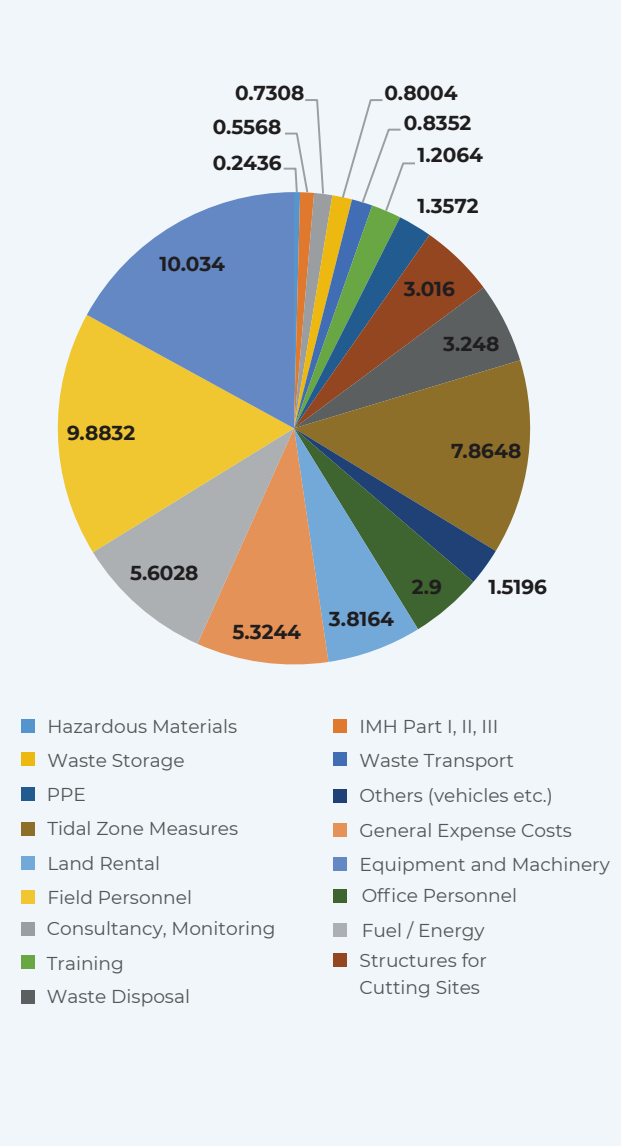
5.4. Cost Risks in Shipbreaking Businesses

An important risk factor in the SR industry occurs to be the risk of an upward increase in the total costs that may arise due to unforeseen changes in the businesses' annual shipbreaking imports, operation, personnel expense, tax etc. costs. Facilities may have difficulty in realizing payments due to factors such as crises in global markets, war, pandemic, natural disasters and the withdrawal of countries, shortage of materials, changes in oil prices etc.

During the interviews held with facilities in Aliağa SR zone, the costs spent for SR activities could not be obtained clearly. The DNV-GL rating society has revealed the additional costs arising out of an environmentally friendly recycling process with a medium-sized SR facility in Aliağa (European Commission (EC), 2016). The facility with which the survey was realized has operated in the recycling field for a long time and had an annual capacity of approximately 50,000 LDT (Figure 38).

In the evaluation, the site investments required for green SR activities were taken into account. In the related calculation, investments were subjected to depreciation ranging from 5 to 20-25 years (floating pier, pontoon, building structures etc.). Cost of capital based on a 6% interest rate was taken into account. The analysis showed that an additional cost of USD 58.94 per LDT (about USD 20 of such for environmentally responsible recycling) was spent to achieve green recycling. This evaluation will vary for different ship types and sizes but covers all the cost elements required for environmentally sound SR. The costs indicated here were calculated on the assumption that the facility already had a waste flow management infrastructure.

FIGURE 38. Costs per LDT at Aliağa SR Facilities (USD) (European Commission (EC), 2016).



5.5. Conclusions and Evaluation

Aliağa SR industry constitutes a heavy industry branch in our region. The heavy workload of the sector increases the potential for serious occupational accidents. In order for the sector to be sustainable, it must strictly comply with national and international rules and regulations, and establish the necessary infrastructure for work and worker safety and health. Even though Türkiye offers better conditions for the SR process, it has a price disadvantage against Bangladesh, India and Pakistan, which perform the most ship recycling operations in the sector through the purchase of scrap ships.

CHAPTER 6.

İzmir Aliağa Ship Recycling Facilities Value Chain Analys

Within the scope of İzmir Aliağa Ship Recycling Sector Analysis, meetings were held with the General Directorate of Shipyards and Coastal Structures, IMEAK Chamber of Shipping Aliağa Branch, Ship Recycling Industrialists' Association. In respect to the companies operating in the sector, interviews were held with Şimşekler Gida Gemi Sokum, Temurtaşlar Gemi Sokum, Aliağa Gemi Geri Donusum, Ege Çelik San. ve Tic., Metaş Gemi Sokum, BMS Gemi Geri Donusum, Sök Denizcilik, Işıksan Gemi Sokum, Anadolu Gemi Sokum, Soylu Gemi Geri Donusum, Kursan Gemi Sokum and Blade Denizcilik Geri Donusum companies.

Phone, e-mail, online meetings and face-to-face interviews were held with four naval architects, one mechanical engineer, one industrial engineer, eight environmental engineers, two operators and four Occupational Health and Safety (OHS) experts working actively at Aliağa SR facilities. Thus, information was obtained about the sector, and the performance values of the factors that were effective in the preference of the methods used in the sector analysis were obtained. In order to verify the performance scores obtained, the opinions of an OHS/ISO/Waste expert experienced in the sector, two purchasing experts, a human resources and quality management system expert, and two shipbuilding engineers were consulted and their contributions were accordingly taken into consideration. Structured questionnaires were applied to the stakeholders. Face-to-face interviews were held with Mr. Ersin Çeviker, who worked as an expert at GEMİSANDER for a long time in the past.

In the following sections, the results of SWOT, Pareto, Five Forces, Kaizen, Six Sigma, PESTLE and Resilience Engineering applications carried out over the data collected within the scope of the sector analysis of Aliağa SR facilities are presented.

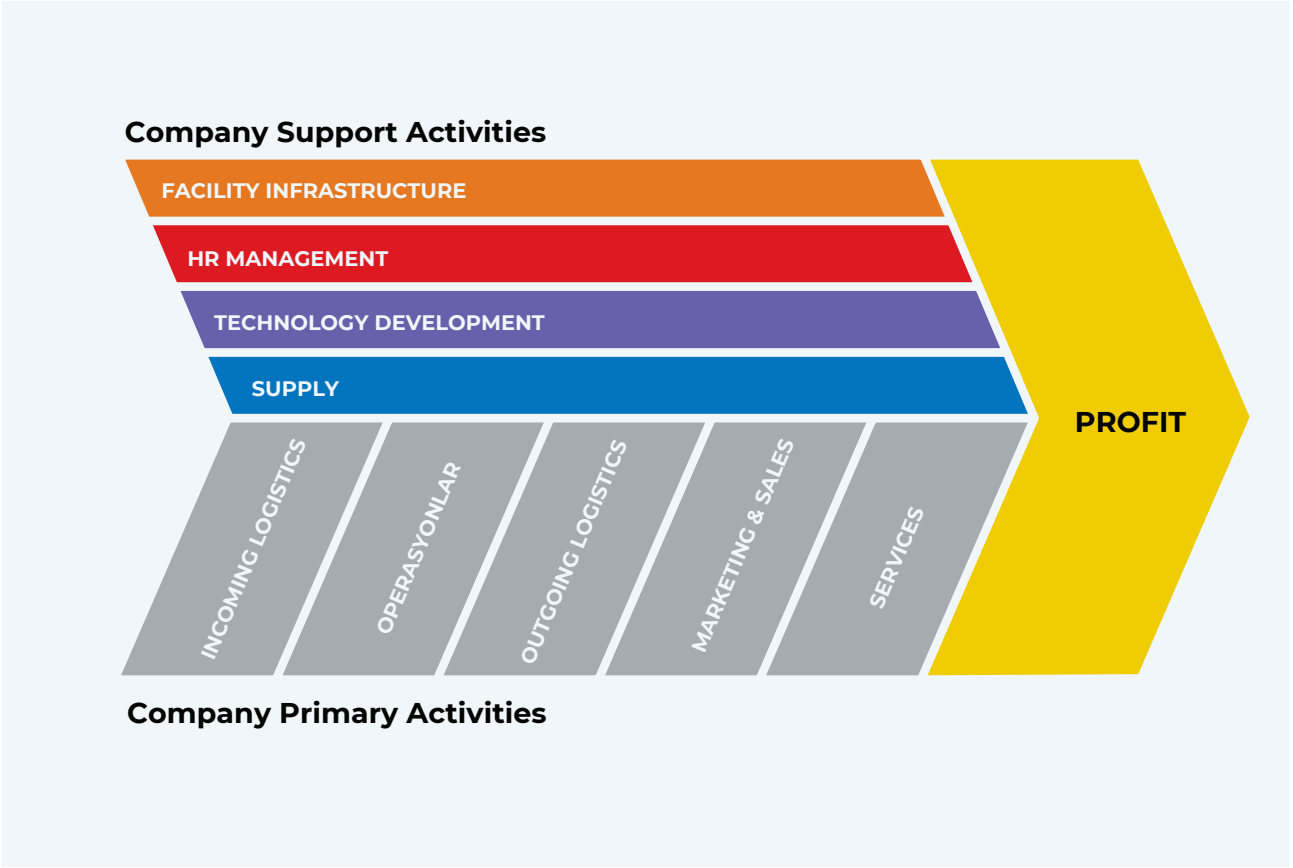
6.1. Sector Analysis

Companies' success is significantly influenced by their strategies. The company's objectives (short, medium and long term), resources and capabilities, structure and systems, and the industry's natural environment (competitors, customers and suppliers) serve as the foundation for the strategy. It is essential to consider these components in the planning. Strategy is not only about how companies will compete, but also about what will happen in the future (Grant, 2019). Although the main purpose of companies is to make a profit, entrepreneurs and creatives definitely have goals they want to achieve. The ultimate goal of all companies is to create value. Porter and Kramer (Porter & Kramer, 2011) stated that every value created economically also creates a value in society.

A company's competitive advantage stems from its ability to perform important operations in the value chain better than its competitors (T.C., TR 07R2.02-01). Value chain analysis is a strategic tool used to analyse internal activities. Its purpose is to recognize which activities are more valuable to the company and which activities can be developed to gain competitive advantage. The value chain represents all the internal activities a company undertakes to produce goods and services. The value chain consists of primary activities that add value directly to the end product and support activities that add value indirectly (Figure 39).

In the next section, these activities are listed specifically for the SR sector.

FIGURE 39. Porter's Value Chain Model (Porter & Kramer, 2011)



6.2. Primary and Support Activities in the SR Sector

In essence, a value chain is a methodical approach for analysing the development of competitive advantage. Defining the main competence areas of an organization is used as a useful analysis tool in determining the operations that are effective in gaining competitive advantage (T.C., TR 07R2.02-01). SR industry is a type of service industry where recycling service is provided instead of production. For value chain analysis, the primary and support activities of the sector need to be defined and analysed.
In this section, primary activities and support activities of Aliağa SR facilities are discussed in detail. Primary activities at the SR facilities may be listed as follows:

1. **Incoming logistics (raw materials, handling, storage):**
   a. Brokers, sources used for scrap purchases,
   b. Oxygen suppliers,
   c. LPG suppliers,
   d. Construction machinery service suppliers,
   e. Equipment suppliers,
2. **Operations (machines, work stations, tests):**
   a. Pre-cleaning on board:
      i. It is ensured that the areas subject to cutting processes are free from flammable materials.
      ii. Cold cutting is performed for flammable materials.
      iii. It is ensured that the part to be cut is purified from fire sources and flammable materials.
      iv. It is ensured that the oils on board are transferred properly.
      v. Spilled oils are cleaned.
      vi. In case of oil leakage, the pipelines are closed.
   b. Hull (lower platform) dismantling:
      i. The connection of the ship with the sea is cut off and the ship is pulled up to the shore waste collection embankments.
      ii. The part of the ship remaining in the water is surrounded by a barrier against spills.
      iii. The machines in the ship are dismantled and removed.
      iv. The machines' equipment in the ship are dismantled and removed, to the extent possible.
      v. If there is waste in the pipe circuits, it is discharged.
      vi. The wastes are discharged to the waste tanker and taken to the temporary storage area.
      vii. During the transfer, necessary equipment for fire/overflow spills are made available.
      viii. Before cutting processes, a written application is made to the Port Authority.
      ix. The port authority official checks the ship and grants permission, if appropriate.
      x. Shipbreaking operations are performed
   c. Secondary section cutting area preliminary cleaning:
      i. Greasy equipment is taken to the pre-cleaning pool and cleaned first, if necessary.
      ii. Combustible materials are removed by use of cold cutting technique.
   d. Marine and soil pollution prevention measures:
      i. During the dismantling operations, the barrier is kept in the sea.
      ii. ii. In case of contamination, cleaning works are carried out.
      iii. iii. Sufficient cleaning materials are made available in the emergency room.
      iv. iv. The materials in the emergency room are checked regularly and the deficiencies, if any, are eliminated.
      v. v. An oil pollution emergency response kit is made available on the shore.
      vi. vi. Greasy water is collected in the drainage channel that intersects the cutting area horizontally, preventing marine and soil pollution.
      vii. vii. Drainage channels are cleaned regularly.
      viii. viii. Wastes are disposed of in incineration plants.
   e. Fire prevention activities:
      i. Combustible and explosive materials are removed from the ship.
      ii. If there are cargo wastes, they are removed.
      iii. Insulation materials are removed. Portable fire extinguishers with dry chemical powder are kept ready.
      iv. During the cutting operations, at least 2 water pumps work at idle by circulating sea water, and sufficient length of fire hose and dual-purpose nozzles are kept ready.
      v. In order to prevent explosion and fire risks, the oil and fuel pipes and the bolts of the valves are not cut, they are loosened and removed with a wrench.
      vi. Fire stations are kept ready during the cutting activities.
   f. Regular inspection of protection and grounding equipment
   g. Regular inspection of construction equipment and operator licenses
   h. First aid and emergency response
   i. Systematic reporting of occupational accidents
   j. Systematic reporting of occupational accidents
   k. Explosion Protection Measures:
      i. Explosive/flammable materials are removed before dismantling operations.

ii. Before cutting, a degassing specialist is engaged to check the site and a hot processing permit is obtained.
iii. Welders and their assistants are subjected to job descriptions training. Torches are checked before each dismantling. The compliance of the torch hoses with the standards is checked.
iv. LPG storage area is checked by the authorized company once a year and storage area safety controls are made during internal audits.
v. LPG and oxygen storage area tank grounding is checked and reported once a year by the accredited institution.
vi. Hot processing is not performed in closed storage areas.
vii. Site LPG and oxygen batteries are turned off at the main valve at the end of lunch/work time. Necessary measures are taken for this, and those responsible are previously appointed to relevant tasks.
viii. The cylinders used in cafeterias and repair shops are kept inside a special transport vehicle and not exposed to direct sunlight.

l. Reporting

3. Outgoing logistics (storage and distribution of finished works):
a. Disposal facilities,
b. Waste transport vehicle suppliers,
c. Zero waste collector municipality,
d. Iron and steel factories,
e. Rolling mills.

4. Marketing and sales (advertising, pricing, channel relations):
a. Used equipment buyers, local buyers in the shipbreaking zone,
b. Hotels and lathe workshops (Gyro, lifeboat, lathe etc.).

5. Services (repair, maintenance, product update, spare parts)
a. Services received:
i. Ambulance and firefighting service (GEMİSANDER),
ii. Hazardous material disposal service,
iii. IHM service,
iv. Occupational safety and health service,
v. Catering service,
vi. Disinfection service,
vii. Towage service,
viii. Agency service,
ix. Piloting service,
x. Radiation measurement service,
xi. Pesticide spraying service,
xii. Gas free service,
xiii. Hot processing permit service,
xiv. Training service.

b. Waste Inventory and IHM comparison reporting
i. Hazardous materials,
ii. Fuel wastes,
iii. Detection of ozone depleting substances,
iv. Detection of wastes on ships with IHM reports,
v. In case IHM part 1 exists, identification of wastes within the scope of parts 2 and 3,
vi. Initial visual insulation examination in areas and equipment that may contain asbestos within the scrap ship,
vii. Provincial Directorate of Environment, Urbanization and Climate Change scrap ship inspection process,
viii. Merchant ships notification approval procedures
- Hazardous waste inventory/IHM comparison report,
- Breathable air report,
- Radiation measurement report,
- Shipbreaking plan,
- Gasfree report,
- Notification form,
- Witness report,
- Fuel wastes survey report,
- Freon gas survey report,
- Provincial Directorate of Environment, Urbanization and Climate Change audit report,
- Permit processes payment receipt,
- Mobile Waste Tracking System (MOTAT) record of solid wastes,
- Photo proving that a barrier was set up next to the ship.

c. Visitors visiting the site
d. Health and hygiene

The support activities of the SR sector may be listed as follows:

1. Facility infrastructure consists of general management, accounting, finance, strategic planning and IT departments. Furthermore, it provides the following activities that assist the primary activities.
a. a. Site layout and site plan,
b. Warning and caution signs.

2. HR management
a. Workplace entry procedures and health reports,
b. OHS and other trainings,
c. Use of personal protective gear.

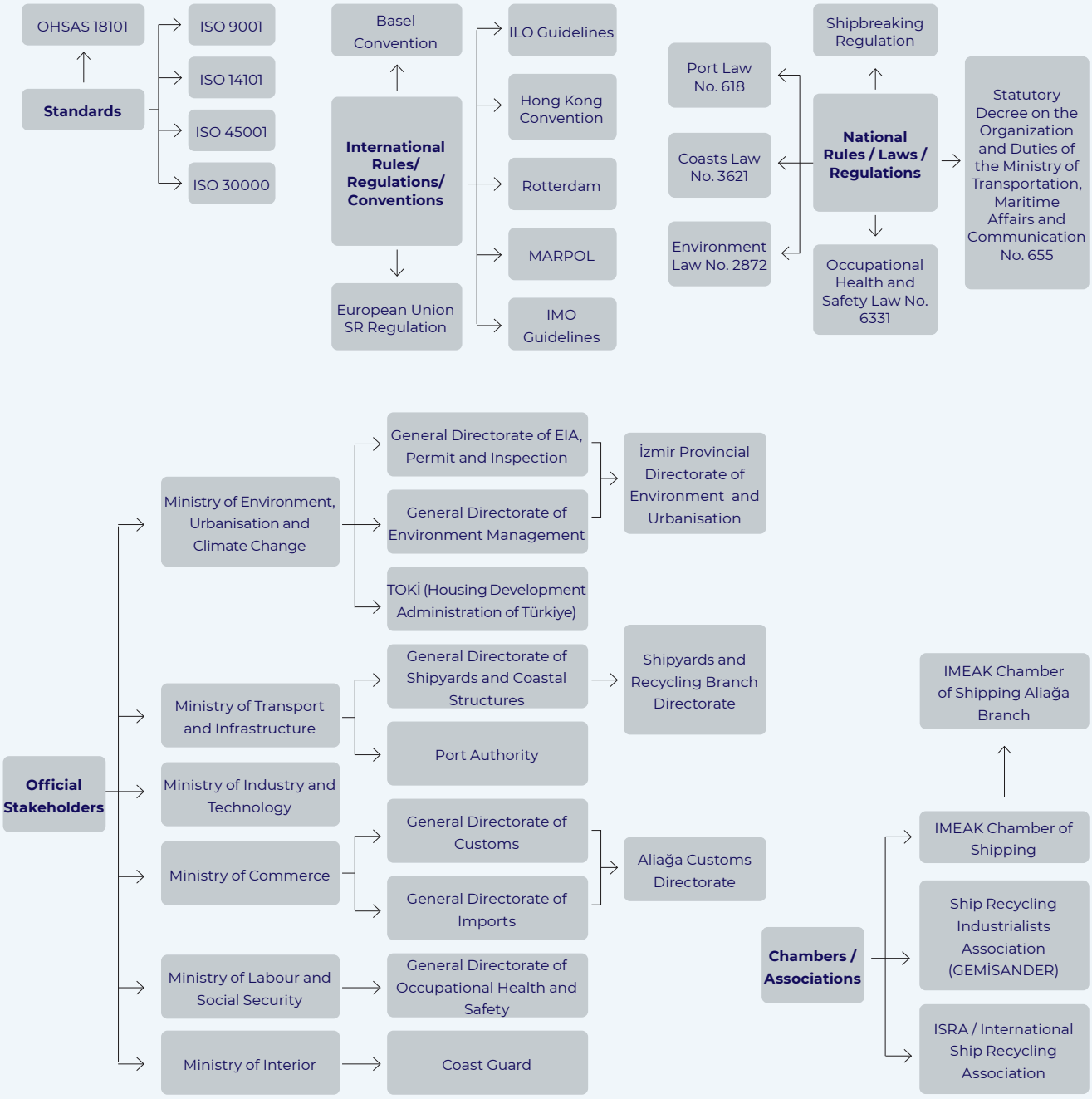
3. Technology development
a. R&D,
b. Product or process improvement.

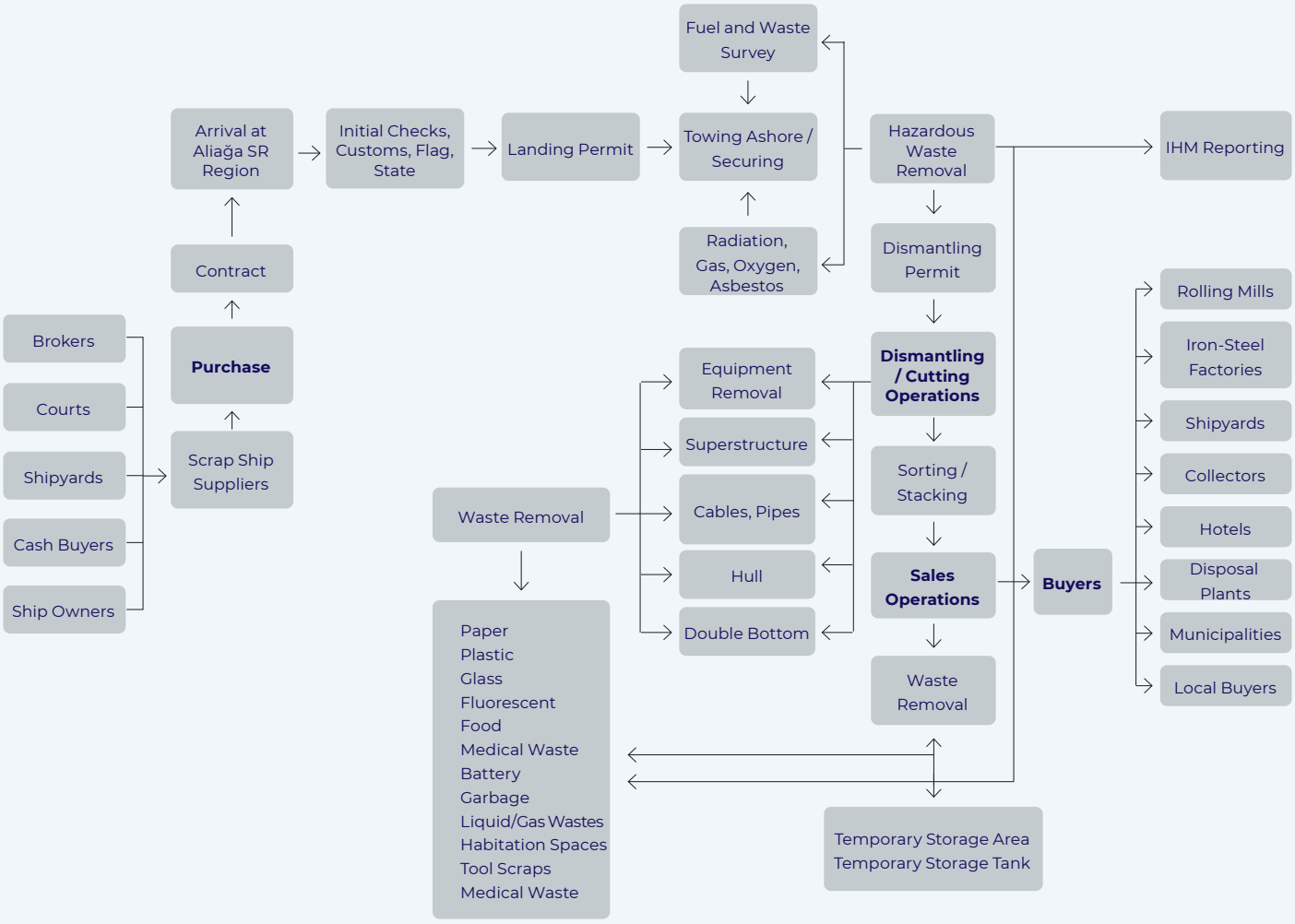
4. Supply
a. Raw materials supply,
b. Machinery and equipment supply,
c. Operational materials supply.

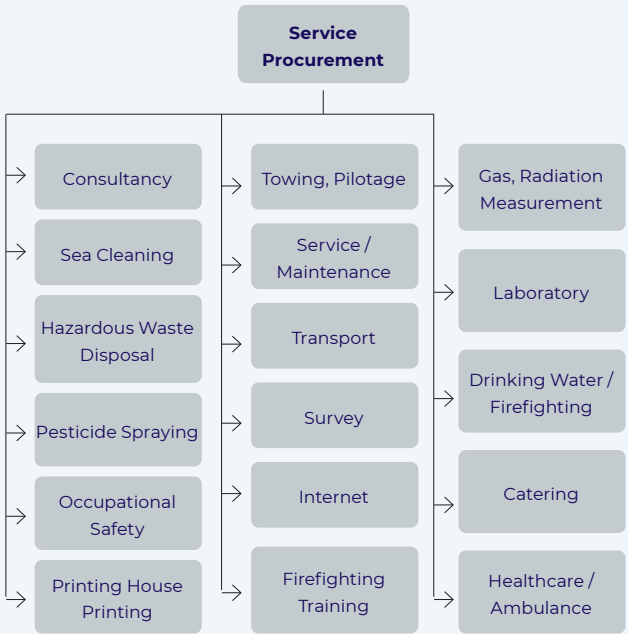
6.3. Value Chain Activities Connections and Relations

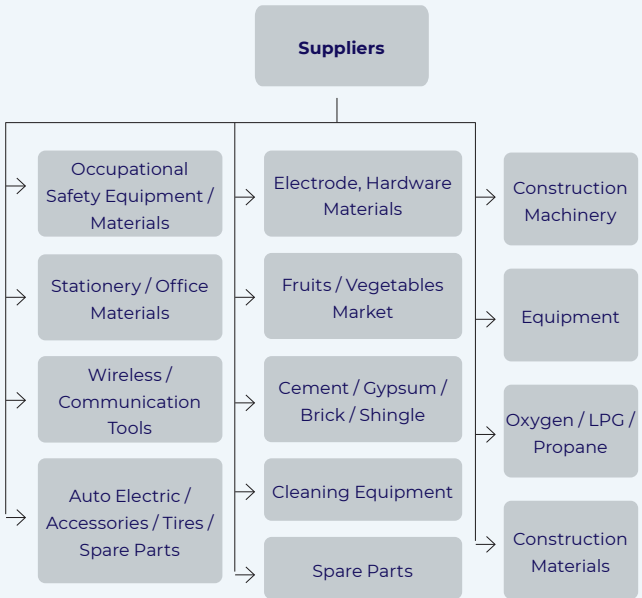
A value chain map was created in order to better evaluate the elements that create value in İzmir Aliağa SR facilities, as shown in Figure 40. This map includes the main processes of the value chain, the main actors in these processes, product flows and connections. This chain of relations will be used as a tool to determine the areas where companies can compete and develop.

FIGURE 40. Aliağa Shipbreaking Facilities Value Chain Map




Fuel and Waste Survey
Arrival at Aliağa SR Region
Initial Checks, Customs, Flag, State
Landing Permit
Towing Ashore / Securing
Hazardous Waste Removal
IHM Reporting
Radiation, Gas, Oxygen, Asbestos
Dismantling Permit
Contract
Brokers
Purchase
Courts
Shipyards
Scrap Ship Suppliers
Cash Buyers
Ship Owners
Equipment Removal
Dismantling / Cutting Operations
Rolling Mills
Iron-Steel Factories
Shipyards
Collectors
Hotels
Disposal Plants
Municipalities
Local Buyers
Superstructure
Sorting / Stacking
Waste Removal
Cables, Pipes
Sales Operations
Buyers
Hull
Double Bottom
Waste Removal
Paper
Plastic
Glass
Fluorescent
Food
Medical Waste
Battery
Garbage
Liquid/Gas Wastes
Habitation Spaces
Tool Scraps
Medical Waste
Temporary Storage Area
Temporary Storage Tank


Service Procurement
Consultancy
Towing, Pilotage
Gas, Radiation Measurement
Sea Cleaning
Service / Maintenance
Laboratory
Hazardous Waste Disposal
Transport
Drinking Water / Firefighting
Pesticide Spraying
Survey
Occupational Safety
Internet
Catering
Printing House Printing
Firefighting Training
Healthcare / Ambulance


Suppliers
Occupational Safety Equipment / Materials
Electrode, Hardware Materials
Construction Machinery
Stationery / Office Materials
Fruits / Vegetables Market
Equipment
Wireless / Communication Tools
Cement / Gypsum / Brick / Shingle
Oxygen / LPG / Propane
Auto Electric / Accessories / Tires / Spare Parts
Cleaning Equipment
Spare Parts
Construction Materials

6.4. SWOT Analysis

SWOT (strengths, weaknesses, opportunities and threats) analysis is a technique used for evaluating a business' competitive position and accordingly developing strategic plans. In this analysis, the strengths and weaknesses of the business are determined and countermeasures are developed by identifying threats and opportunities arising from the external environment.

A comprehensive literature review was conducted on the strengths and weaknesses of İzmir Aliağa SR facilities, along with the threats and opportunities that the sector is exposed to, and then the sector was comprehensively evaluated by holding online meetings with experts, of which results are as examined below (Figure 41).

6.4.1. Strengths

S1. Ship Recycling in Compliance with International Rules and Regulations: The most shipbreaking in the world is performed in Bangladesh, India and Pakistan in South Asia. These countries do not sufficiently comply with international rules and standards, and the SR process is carried out by beaching, which is considered a very primitive method. Due to its nature, this technique poses serious risks for the environment and people in the SR process. Türkiye's use of a more environmentally friendly method of shipbreaking and the determination to comply with international rules and standards are its strengths. Türkiye is in an advantageous position compared to Bangladesh, India and Pakistan, since SR operations are performed by use of landing method. There is an emergency response infrastructure for the facilities, and quick reactions are able to be taken on environmental protection, work and worker safety when necessary.

S2: Use of Recycled Materials: There is significant need for materials obtained by shipbreaking in the domestic market, both in the shipbuilding sector and in other industries. In this way, the raw material needs of iron and steel factories and rolling mills can be met to some extent, which reduces the import of scrap raw materials and reduces the import scrap procurement costs of the factories. Furthermore, the SR sector also contributes to increasing the production quality standards of flat iron and steel products.

S3: Proximity of Facilities and Sub-Industry: The facilities that are involved in shipbreaking in Türkiye are centralized in the Aliağa District. The coexistence of shipbreaking facilities and the sub-industry has created strong links that allow the industry as a whole to move and flourish.

S4: Waste Management: There are facilities suitable for waste management in Aliağa and these facilities fully comply with the international norms.

S5: Labour Potential and Worker Wages: Türkiye has significant experience in the shipbreaking industry and is self-sufficient in qualified workforce at all levels. In terms of worker wages, it is cheaper than other SR industries excluding South and East Asian countries.

6.4.2. Weaknesses

W1: Lack of Space: Due to the fact that different industries operate in Aliağa District, there is not enough space for the expansion of SR facilities.

W2: Insufficient Government Support: The absence of any significant government support, apart from the regulation on the taxes of imported ships, for the SR sector is an obstacle to the growth of the sector.

W3: Capital and Financing Issues: The problems faced by the companies in the sector in finding capital, financing insufficiency and finding loans, and the high loan costs come up as problems for the industry.

W4: Resisting Global Technology Advances: As in many traditional sectors, companies in the SR sector have resistance to change. It has been observed that the facilities are reluctant to invest in R&D and technology.

W5: High Cost Ship Recycling: Another weakness of the Aliağa SR industry is that the shipbreaking costs are higher compared to the South and East Asian countries, where activities far from international standards are intensively utilized. Environmental approaches are always more costly.

W6: Lack of Communication with the Press and Public: The shipbreaking process is dangerous and involves serious risks for the environment, and work and worker health. The industry is under pressure as a result of this predicament and is constantly on the public's agenda. The failure to carry out efficient communication and information actions for the public that state that new generation ship conversion services are offered and environmental techniques are applied in Türkiye comes up as a severe weakness.

6.4.3. Threats

T1: Political Uncertainties: The long-term uncertainty of the political situation increases the uncertainties that the sector may face and constitutes a threat to the sector.

T2: Economic Structure: Along with regional and international tensions, the fragile structure of the economy constitutes a threat to the sector.

T3: Foreign Currency Movements: The fluctuating currency movements observed recently is an important issue that requires the attention of the sector. Türkiye's high Credit Default Swap (CDS) also negatively affects foreign exchange flow and investments in the country.

T4: Potential Sanctions: From time to time, sanction decisions may develop depending on political conditions, and such developments may affect the number of ships coming for recycling from the EU.

T5: Uncertainty Regarding Land Ownership: The land where the facilities are located belongs to TOKİ, and with the contract expiry in 2026 and the uncertainty of renewal, this situation constitutes a threat for the sector.

T6: Uncertainties During and After Covid-19: As in all sectors throughout the world, the SR sector is also affected by the pandemic. Although shipbreaking facilities have turned the crisis into an opportunity, uncertainties always have unforeseen dimensions. The expectation that the pandemic will persist for a long time and the uncertainties about the recovery process to be experienced after the pandemic in the world are being tracked by the sector.

T7: Lack of R&D: There is considerable experience in the removal and disposal of hazardous materials and waste in Aliağa. However, research and development studies are lacking on issues such as the disposal of unpredictable hazardous wastes. The fact that the businesses located in the sector do not have R&D units creates deficiencies in improving work processes and raising the level of technology.

T8: Public Pressure: Although the sector demonstrates the ability to use up-to-date techniques for the control and disposal of hazardous wastes, this issue will remain a threat if public pressure is not managed well. .

T9: High Labour Wages Compared to South Asian Countries: Labour wages are very low in the South Asian countries enjoying the highest SR figures in the world.

T10: Other Countries' High Price Payments for Scrap Ships: South Asian SR facilities pay high prices for the purchase of scrap ships, which causes especially high tonnage ships to be sold in the Asian market and recycled in the relevant facilities. Ship or fleet owners change the flag of their ships and sell them afterwards in order to avoid possible international sanctions and penalties.

T11: Fluctuations in Steel Prices: Fluctuations in steel prices and value changes may cause losses in the sector. In addition, the crisis in the global markets and the decline in steel demand have a serious threat potential for the sector.

6.4.4. Opportunities

O1: Compliance with EU Ship Recycling Regulation: Aliağa SR Facilities have made preparations towards complying with the requirements of the EU's SR Regulation, and thus Türkiye achieved the status of the country that entered the EU list with the most facilities (eight facilities). The inspection of nine applicant facilities is underway and the remaining five facilities are also preparing for application. With this regulation, which is valid as of 31 December 2018, the recycling of EU flagged ships can only be performed at the facilities included in the list. Considering that 1.5-2 million LDT of EU-flagged vessels are recycled annually, this will create a significant added value for Türkiye.

O2: Position within the European Region: As a country with a high-capacity SR industry in the European region, being close to European countries provides a significant advantage for Türkiye.

O3: Entrepreneurship: The entrepreneurial nature of the Turkish people contributes to the ability to develop a rapid reaction to the changing structure of the sector and to create new opportunities.

O4: Young Population Structure: Shipbreaking industry and its sub-industry branches have important employment opportunities for Türkiye's young population. Further employment will also be created with the expansion and productivity increase in the shipbreaking facilities.

O5: Geographic Location Advantage: It has very important implications that there is no competitor performing high-capacity SR activities within the geography where Türkiye is located. Türkiye is a significant buyer capable of recycling EU ships and has sufficient facility capacity to dismantle potential scrap ships from Europe.

O6: The Effect of Slowdown in Global Growth: There are serious decreases experienced in global growth and there is a concern that this situation will continue for a long time throughout the world. This situation creates an expectation of an increase in the number of scrapped ships.

O7: Increase in the Number of Ships to be Scrapped Due to the Pandemic: Due to the pandemic, many ship or fleet owners face significant economic crisis. Some ship owners, who deeply feel the effects of this process, consider that it would be better to have their ships scrapped in order to reduce costs.

FIGURE 41. Aliağa Ship Recycling Facilities SWOT Analysis

STRENGTHS

- **S1** Ship recycling in compliance with international rules and regulations
- **S2** Use of recycled materials in shipbuilding and other industries in the domestic market
- **S3** Having all shipbreaking facilities located together inside Aliağa District
- **S4** Presence of facilities suitable for waste management
- **S5** Labor potential and worker wages

WEAKNESSES

- **W1** Insufficient space to respond to the expansion need of facilities
- **W2** Lack of government support
- **W3** Capital and Financing Issues
- **W4** Resisting Global Technology Advances
- **W5** Ship recycling at high cost compared to South and East Asian countries
- **W6** Lack of communication with the press and the public

S W T O

THREATS

- **T1** Political uncertainties
- **T2** Economic structure
- **T3** Foreign currency movements
- **T4** Potential sanctions
- **T5** Uncertainty regarding land ownership
- **T6** Uncertainties during and after the pandemic
- **T7** Lack of R&D
- **T8** Public pressure
- **T9** High labor wages compared to south asian countries
- **T10** Other countries' high price payments for scrap ships
- **T11** Fluctuations in steel prices

OPPORTUNITIES

- **O1** Türkiye being the country that had the most facilities included in the EU ship recycling regulation compliance list
- **O2** Türkiye being the only country with SR industry in Europe region and located close to European countries
- **O3** Entrepreneur nature of Turkish people
- **O4** Young population
- **O5** Absence of competitors in Türkiye's geography
- **O6** Expected increase in ships to be scrapped due to slowdown in global growth
- **O7** More shipowners becoming willing to sell their ships for recycling due to the pandemic

6.4.5. Advanced SWOT Analysis

There are various limits to the SWOT analysis performed for the Aliağa SR facilities, thus it cannot be employed exclusively in the situation analysis. It serves as a reference for further analysis. With an advanced SWOT analysis for SR facilities, the priority values of the factors can be determined and thus a more rational perspective can be presented. The purpose of the advanced SWOT is to determine the strengths and weaknesses of the industry, the threats it is exposed to, and the importance of the opportunities it has.

The strengths and weaknesses of Aliağa SR facilities were evaluated under 3 categories.:

Importance: The importance of the strengths (or weaknesses) of İzmir Aliağa SR facilities is obtained. For each strength (or weakness), values between 1 (slightly important), 2 (somewhat important), 3 (moderately important), 4 (important) and 5 (very important) is assigned.

Evaluation: Values between 1 (slightly strong), 2 (moderately strong), and 3 (very strong) is given to each factor for the strengths of the SR facilities. Likewise for weaknesses, values between 1 (slightly weak), 2 (moderately weak) and 3 (very weak) are assigned.

Score: This is the outcome of importance multiplied by rank. In this way, a prioritization of strengths and weaknesses is obtained. Strengths and weaknesses of Aliağa SR facilities should be determined and the weakest parts should be strengthened.

Opportunities and threats for Aliağa SR facilities are prioritized slightly differently from strengths and weaknesses. This evaluation includes:

Importance: This shows to what extent external factors can affect İzmir Aliağa SR facilities. For each opportunity (or threat), values between 1 (slightly important), 2 (somewhat important), 3 (moderately important), 4 (important) and 5 (very important) is assigned.

Probability: Probability of happening indicates how likely the impact of an opportunity or threat is for the SR facilities. Here, a value of 1 (low probability), 2 (moderate probability), or 3 (high probability) is assigned.

Score: The product of severity and probability will result in a priority order of opportunities and threats. Opportunities and threats to which Aliağa SR facilities have should be determined and strategies should be developed to eliminate or at least reduce the effects of especially high-priority threats.

Aliağa SR Facilities SWOT Analysis expert evaluation results are shown in Appendix B. Based on the answers given by 20 experts, the priority ranking scores of the strengths and weaknesses of the Aliağa SR facilities, the opportunities they have and the threats they are exposed to were obtained and are shown in Table 7 through Table 10 below. The following inferences were made by evaluating the results obtained.

- The strongest feature of the facilities is considered to be 'Recycling ships in compliance with international rules and regulations' (Table 7). The rising awareness throughout the world is driving up the demands for green SR activities. Türkiye has a rightful place in the sector with its green recycling operations.
- The weakest feature of the shipbreaking facilities is considered as 'Lack of space to respond to the expansion demand for facilities' (Table 8). Different industrial branches operate around the land where the sector is located, and it does not seem possible for the facilities to expand their land use along the coast.
- The biggest threat to the shipbreaking facilities in İzmir stands out as 'Uncertainty regarding land ownership' (Table 9). The fact that the companies do not have land ownership rights is a cause for serious concern.
- The biggest opportunity for the shipbreaking

facilities is currently considered as 'More ship owners becoming willing to sell their ships for recycling due to the pandemic' (Table 10). The SR industry is among the sectors positively affected by the pandemic.

TABLE 7. The weights of the factors indicating strengths for Aliağa SR facilities

Strengths	Score
S1: Recycling ships in compliance with international rules and regulations	0.24
S2: Use of recycled materials in shipbuilding and other industries in the domestic market	0.17
S3: Having all shipbreaking facilities located together inside Aliağa District	0.20
S4: Presence of facilities suitable for waste management	0.22
S5: Labour potential and worker wages	0.16

TABLE 8. The weights of the factors indicating weaknesses for Aliağa SR facilities

Weaknesses	Score
W1: Insufficient space to respond to the expansion need of facilities	0.24
W2: Lack of government support	0.15
W3: Capital and financing Issues	0.13
W4: Resisting global technology advances	0.18
W5: Ship recycling at high cost compared to South and East Asian countries	0.16
W6: Lack of communication with the press and the public	0.14

TABLE 9. The weights of the factors indicating threats for Aliağa SR facilities

Threats	Score
T1: Political uncertainties	0.11
T2: Economic structure	0.11
T3: Foreign currency movements	0.11
T4: Potential sanctions	0.12
T5: Uncertainty regarding land ownership	0.15
T6: Uncertainties during and after the pandemic	0.04
T7: Lack of R&D	0.07
T8: Public pressure	0.09
T9: High labour wages compared to South Asian countries	0.05
T10: Other countries' high price payments for scrap ships	0.09
T11: Fluctuations in steel prices	0.08

TABLE 10. The weights of the factors indicating opportunities for Aliağa SR facilities

Opportunities	Score
O1: Türkiye being the country that had the most facilities included in the EU ship recycling regulation compliance list	0.15
O2: Türkiye being the only country with SR industry in Europe region and is located close to European countries	0.14
O3: Entrepreneur nature of Turkish people	0.10
O4: Young population	0.13
O5: Absence of competitors in Türkiye's geography	0.12
O6: Expected increase in ships to be scrapped due to slowdown in global growth	0.15
O7: More ship owners becoming willing to sell their ships for recycling due to the pandemic	0.19

6.5. Pareto Analysis

Pareto analysis is a bar chart used to separate significant causes of a issue/problem/risk from relatively minor causes. Pareto analysis has been performed to separate the significant threats from the relatively minor threats for the İzmir Aliağa SR facilities. In this respect, advanced SWOT analysis expert evaluation scores were used within the scope of Pareto analysis.

There are a total of 11 threats to Aliağa SR facilities (Figure 42). When the threat priority rankings are evaluated, it is observed that the threats "T5: Uncertainty regarding land ownership", "T4: Potential sanctions", "T1: Political uncertainties", "T2: Economic structure" and "T3: Foreign currency movements" have 60% performance value. Therefore, it will be much more effective to focus on these five issues first if the threats to the facilities are to be improved.

6.6. Five Forces Analysis

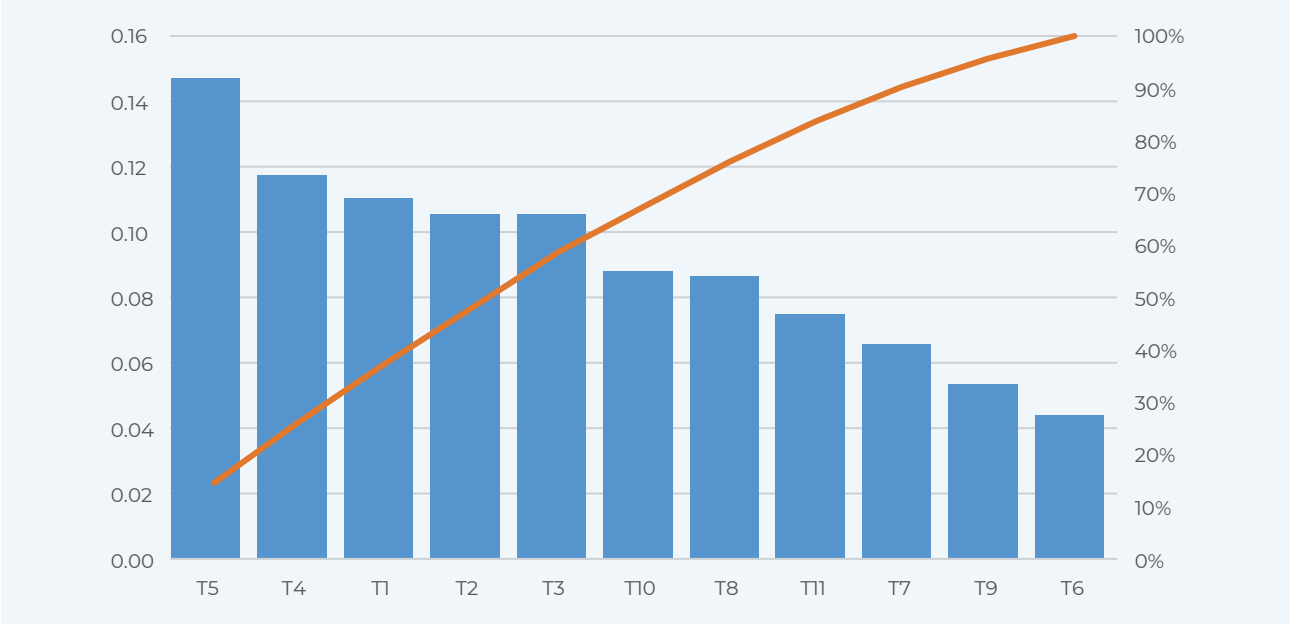
Michael Porter's (1979) Five Forces Analysis is a form of strategic analysis that helps companies evaluate industry attractiveness, how trends will affect industry competition, what industries a company should compete in, and how companies can position themselves for success.

In the field studies of Aliağa SR facilities, the following threats and their sub-factors that will affect the sector were assessed in the five forces analysis expert evaluation:

- Threat of new entrants
- Bargaining power of suppliers
- Bargaining power of buyers
- Threat of substitute products
- Rivalry among existing competitors

In the evaluation of the questionnaires made in this context, the averages of the scores given by 20 experts were taken. A scale with the values 1: very low, 2: low, 3: moderate, 4: high, and 5: very high was used to evaluate performance scores in the survey. The information obtained as a result of extensive literature studies and interviews with experts is examined below.

FIGURE 42. Pareto Analysis of Threats to İzmir Aliağa SR Facilities



6.6.1. Threat of New Entrants

Current Situation: Facilities providing SR service in the world are deployed in certain countries in Asia, Europe and America (England, America, Norway, Netherlands, Spain, Portugal, China, India, Bangladesh, Pakistan, Türkiye, Denmark, Ireland, Estonia, France, Italy and Finland). 85% of SR is performed in Bangladesh, Pakistan and India in South Asia. According to 2020 data, Bangladesh, India, Pakistan, Türkiye and China are recycling 98% of the total LDT.

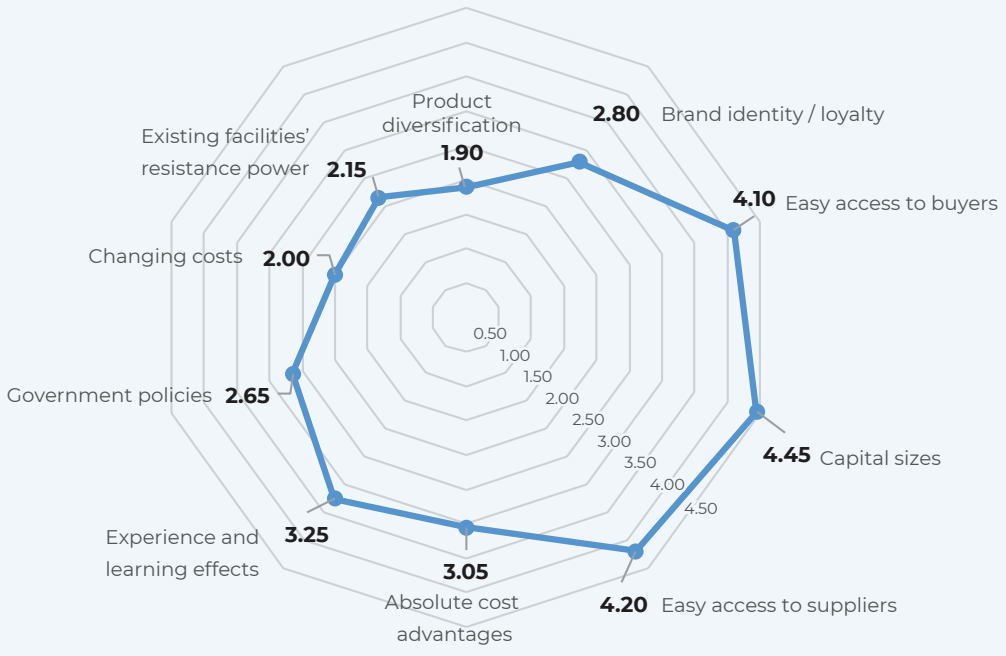
Analysis: Due to low labour costs and high scrap steel demands, South Asian countries are the countries with the most SR activities. Environmental investments, mechanization and waste disposal costs are low and they receive government support for SR operations. The government support aims at the continuity of employment in the sector, the reduction of scrap imports by supplying the scrap raw material needed by the country's domestic market, and the reduction of foreign dependency.

In Europe, there are few SR facilities in countries other than Türkiye, and in addition, their capacities are low and they focus on recycling special types of ships.

The costs of the investments to be made for achieving green SR are high. In addition, the efforts of international authorities to introduce new regulations and rules for more environmentally friendly shipbreaking require additional costs and high capital. The geographical location of SR facilities in the world is also important. In addition to the high costs and geographical location, the operations to be performed require professional experience and knowledge. Considering such obstacles, SR facilities serving in Aliağa do not consider new facilities to enter the market as a threat.

The impact of new entrants on İzmir Aliağa SR facilities is shown in Figure 43. In the event of a new SR facility joining the sector, their "capital volumes", "easy access to suppliers", and "easy access to customers" are seen to be the biggest threats.

FIGURE 43. Threat of new entrants



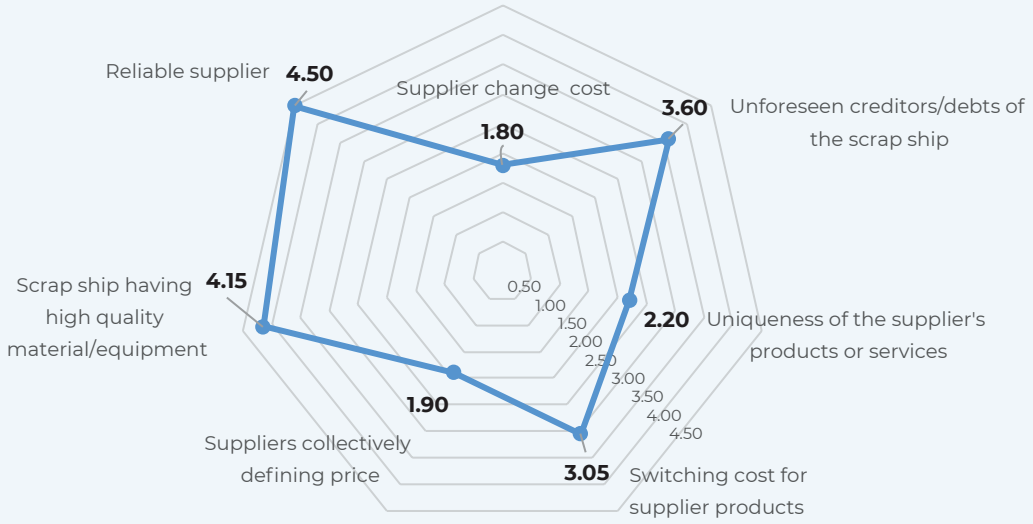
6.6.2. Bargaining Power of Suppliers

Current Situation: Scrap ships or scrap offshore buildings are the primary commodities entering the SR business. Facilities performing SR purchase scrap ships from shipyards, ship owners, intermediaries, cash buyers or enforcement courts.

Analysis: Türkiye has no chance to compete with the scrap ship purchase price offers of South Asian countries. While Bangladesh, India and Pakistan offer $585-615/tonne to suppliers for scrap ship purchases, Türkiye offers $275-295/tonne (Go Shipping and Management Inc, 37th week prices for 2021). When these data are examined, the price offered in South Asian countries in the first 4 months of 2021 is observed to be around 500 dollars/ton in the 17th week, and increase to around 600 dollars/tonne in the 37th week. The offer prices by the facilities in Aliağa were around $260/ton in the 17th week, and remained at around $295/tonne in the 37th week. It is not commercially possible for Turkish SR companies to give a price for scrap ships higher than the sale price of scrap. The feature that makes Türkiye advantageous in bargaining power is that it performs shipbreaking in accordance with international conventions and is the country that entered the EU list with the highest number of facilities. In addition, sea voyage of scrap ships in the European region to South Asia creates serious risks due to changing environmental conditions, problems that may be experienced in the ship's propulsion system and additional costs.

The effect of suppliers and relations with suppliers on İzmir Aliağa SR facilities is shown in Figure 44. When the results thus obtained are examined, “Reliable Supplier” and “Scrap ship having high quality material/equipment” were calculated as the most important factors. “Unforeseen creditors/debts of the scrap ship” can pose a serious risk for the facilities. In addition, “Scrap ship having high quality material/equipment” provides ease of sale and high profit benefits, especially in the second-hand market. For this reason, it is a very important criterion in ship purchase offers from facility owners. “Reliable suppliers” is always an important issue for facilities, while this can also bring additional costs.

FIGURE 44. Bargaining power of suppliers

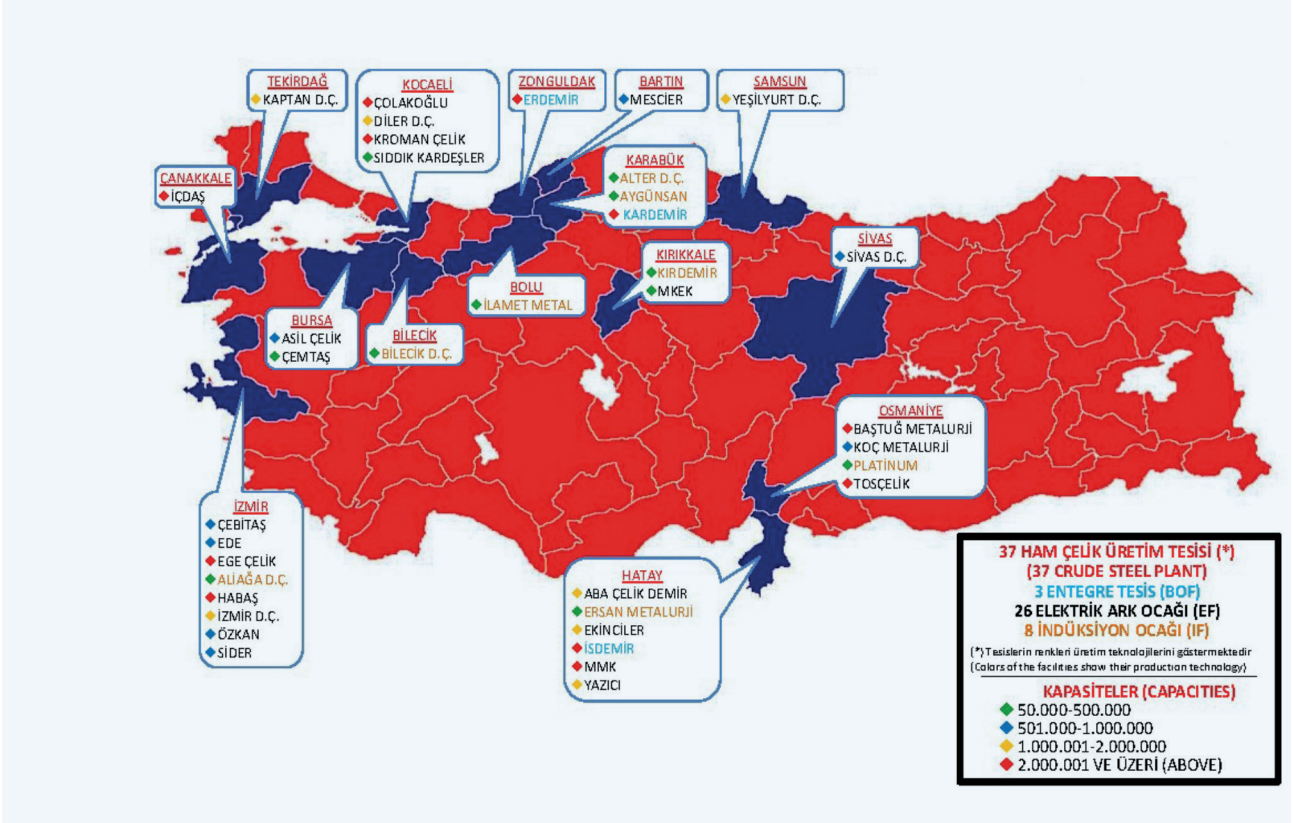


6.6.3. Bargaining Power of Buyers

Current Situation: Buyers in this industry consist of iron and steel plants, rolling mills, antique shops, shipyards, hotels and waste disposal facilities.

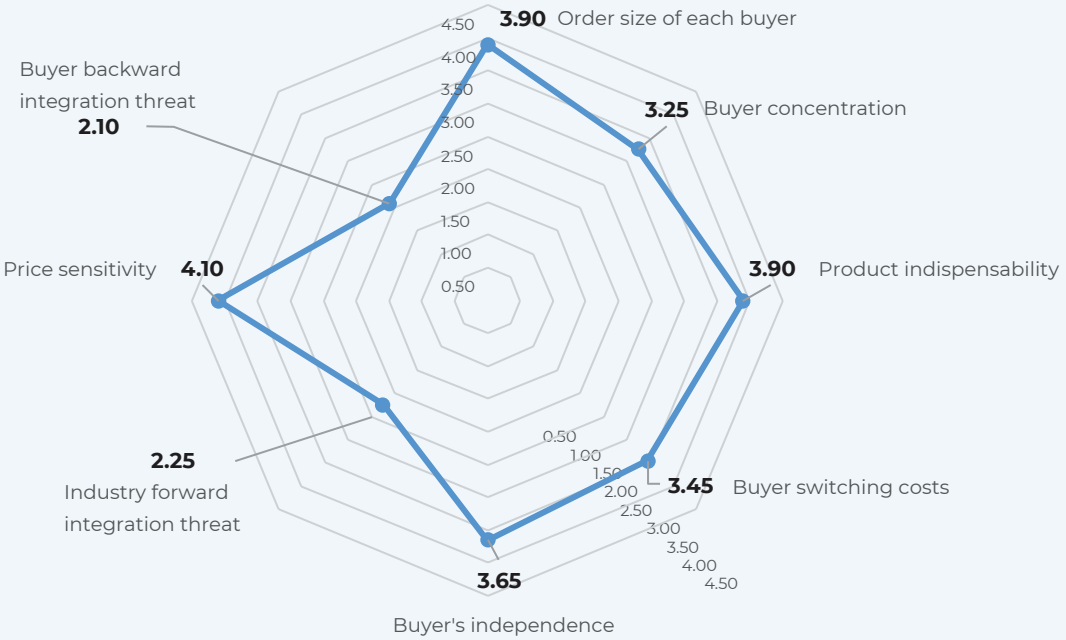
Analysis: The main reason for the establishment of SR facilities in Aliağa is to meet the raw material needs of 8 iron and steel factories operating in İzmir (Figure 45). The facilities can sell the scrap steel they produce to the iron and steel factories across the areas close to İzmir (Marmara region) at a higher price of 15 USD per tonne, yet this does not seem feasible due to high transportation costs. This situation provides an advantage for iron and steel plants and rolling mills in the region. Steel producers that operate in other regions of Türkiye and are willing to use ship scrap cannot procure shipbreaking scrap from Aliağa due to high transportation costs. Alternative SR facilities need to be established in areas that will not disadvantage steel producers in terms of freight. In addition, the facilities have a policy of immediately disposing of the products obtained as a result of SR without storing them. This is important in respect to emptying the facility site for the recycling of newly incoming ships and ensuring continuity of operations. Scrap iron and steel sales prices are determined by global players. In second-hand material sales, products other than very special and valuable products are either quickly sold to customers at an acceptable price range or cut and sent to rolling mills due to insufficient storage capacity at the facilities.

FIGURE 45. Steel map of Türkiye (TÇÜD, 2021), (Accessed: June 2021)



The effect of bargaining power of buyers on İzmir Aliağa SR facilities is shown in Figure 46. “Price sensitivity”, “buyer order size”, “product indispensability” and “buyer independence” have significant effects on buyer bargaining power. Unpredictable price fluctuations can cause a serious decrease in the profit margins of the facilities.

FIGURE 46. Barganing power of buyers



6.6.4. Threat of Substitute Products

Current Situation: The primary product obtained in the SR process is steel scrap. Most of the liquid steel produced in our country is produced in integrated iron and steel plants with Blast Furnace, Basic Oxygen Furnace (BOF) producing from ore, and Electric Arc Furnace (EAF) (including Induction Furnace) plants producing from scrap.

Analysis: Iron ore quantity in nature is limited, and production from ore has higher energy requirements and carbon dioxide emissions compared to production from scrap. In addition, the scrap steel obtained with SR is of high quality. For this reason, ship scrap steel is in high demand in respect to iron and steel industry scrap purchases. Table 11 shows Türkiye's crude steel production by products and methods.

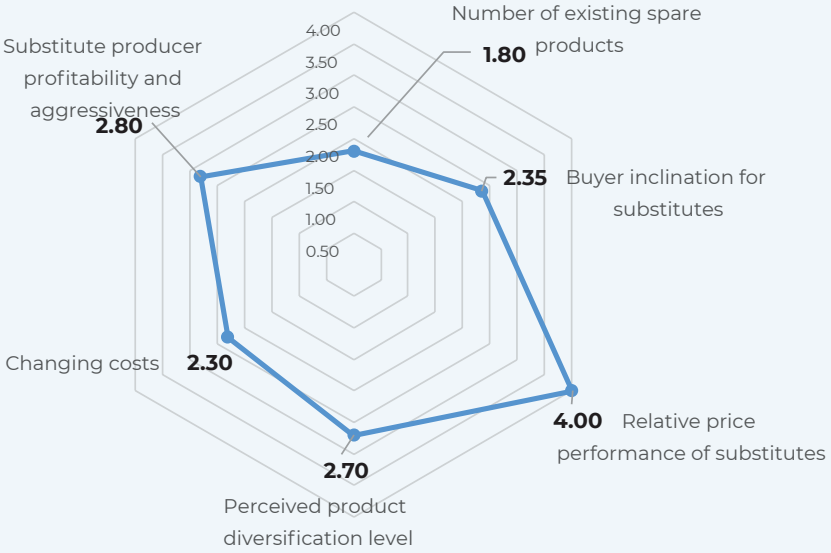
TABLE 11. Türkiye's Crude Steel Production by Products and Methods (Million tonnes) (Republic of Türkiye Ministry of Industry and Technology)

	2015	2016	2017	2018	2019	2020
Long	23,231	23,015	25,839	24,669	20,944	23,234
Flat	8,286	10,148	11,685	12,643	12,799	12,576
TOTAL	**31,517**	**33,163**	**37,524**	**37,312**	**33,743**	**35,810**
EAF	20,482	21,846	25,963	25,799	22,884	24,782
BOF	11,035	11,317	11,561	11,513	10,859	11,028
TOTAL	**31,517**	**33,163**	**37,524**	**37,312**	**33,743**	**35,810**

When the information in the table is examined, it can be observed that Türkiye produced 35,810 million tons of steel in 2020, with scrap steel accounting for almost 69% of this total. About 3% of this is ship scrap steel. Ship sheet metal has a positive effect on production quality and efficiency due to being free from mixed substances and unwanted chemical compositions. Ship plates have the physical (wall thickness, flatness and size) and chemical properties that flat products should have, since they are cut sheet metal scraps. Since shipboard sheet metal is heavy scrap, it also increases energy efficiency. Ship sheet and scrap are in high demand in iron and steel production due to their high quality. Iron and steel factories need ship scrap for the steel products they produce in order to increase the product quality.

The effect of substitute products on İzmir Aliağa SR facilities is shown in Figure 47. Although ship scrap steel is preferred more than scrap steel obtained by recycling other industrial products due to its quality, "relative price performance of substitutes" is an important factor to be considered.

FIGURE 47. Threat of substitute products



6.6.5. Rivalry among Existing Competitors

Current Situation: Türkiye is one of the five countries with the highest SR activity throughout the world.

Analysis: Through the examination of Türkiye's competition with other SR facilities in the world, the following findings have been reached. It is not possible for Türkiye to compete with the prices given by Bangladesh, India and Pakistan for the purchase of scrap ships. Compared to the South Asian SR facilities, the high labour costs, the investment costs for the protection of the environment and work and worker health, and waste disposal costs come up as factors that drive competition to be very challenging. SR activities in Türkiye provide an advantage against South Asian countries with its full compliance with national and international rules and regulations. The requirement that EU flagged ships can only be recycled at the facilities included in the EU Commission Ship Recycling List provides an advantage in SR since Türkiye is already included in this list with a total of 8 facilities.

The effect of "rivalry among existing competitors" on İzmir Aliağa SR facilities is shown in Figure 48. Factors such as "quality differences" and "changing costs" among existing competitors were found to be important.

FIGURE 48. Rivalry among existing competitors

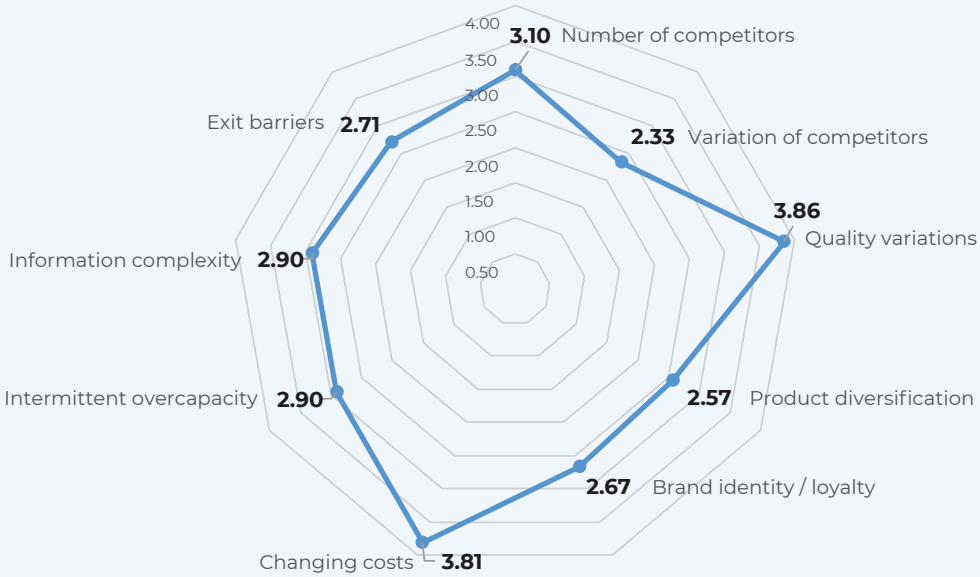
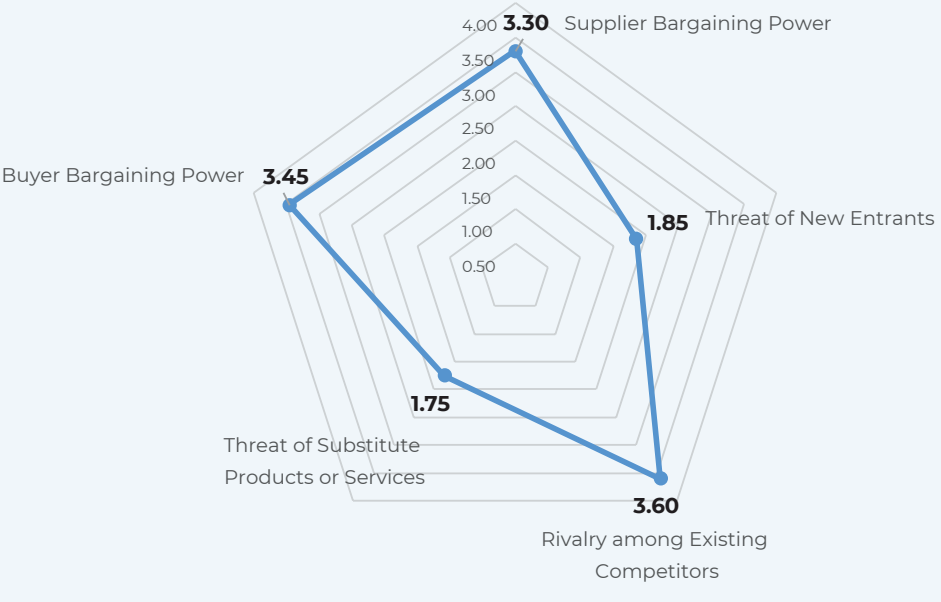


Figure 49 illustrates the performance evaluation results of the main factors in the Five Forces Analysis of SR facilities. Accordingly, "rivalry among existing competitors" has a high level of importance with a performance score of 3.6. Among the performance indicators, "bargaining power of buyers" and "bargaining power of suppliers" have an importance level above medium. Among the performance indicators, "threat of substitute products" and "threat of new entrants" are observed to be of low significance.

FIGURE 49. Aliağa SR Facilities Five Forces Analysis



6.7. PESTLE Analysis

PESTLE analysis, which will be used to question the effects of external environmental factors beyond the control of Aliağa shipbreaking facilities on the value creation process, is named over the initial letters of the words Political, Economic, Sociological, Technological, Legal, and Environmental.

Comprehensive literature studies, expert opinions and the PESTLE evaluation created by SWOT analysis for İzmir Aliağa SR facilities are examined below.

6.7.1. Political

Increasing global awareness across the SR industry has led to rather strict rules and regulations. International institutions such as IMO, UNEP, BC and ILO have published SR guidelines and formed a joint working group. “Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships” was prepared in accordance in the year 2009 and opened for signature.

The publication of the Hong Kong Convention is an important milestone in the SR industry. This convention will force facilities to comply with global regulations. Although the Hong Kong Convention has not entered into force yet, it has started to show its impact on the national legislations and in the SR market of the five countries (Bangladesh, India, Pakistan, Türkiye and China) that have a dominating share of 98% in SR operations.

The European Council came to agreement with the EU Parliament in line with the understanding that the Basel Convention will not successfully regulate the environmental-friendly SR process and the concerns of uncertainties regarding the Hong Kong Convention's entry into force. Thus they adopted the Ship Recycling Law on 27 June 2013, and subsequently the Ship Recycling Law was approved on 22 October 2013 at the main assembly of the EU Parliament and entered into force as of 30.12.2013, followed by the initialization of the implementation process on 31.12.2018. According to this law, ship owners have to choose the facilities they will prefer for recycling from the “EU Commission Ship Recycling List”. Türkiye, which entered the list with the highest number of facilities, has a serious advantage regarding the recycling of ships coming from Europe.

At this point, one of the important issues that may pose a problem for Türkiye is the political tensions that may occur with the EU and its member states. In this perspective, risks such as political uncertainties and the updating of the regulatory framework regarding SR should be emphasized. With global awareness, it is likely that new rules and regulations will be created, and a very good follow-up of the process will be in favour of the SR facilities in Aliağa. Political tensions with the USA as well as the EU may both negatively affect the Aliağa SR sector.

The lack of land ownership by SR facilities and the uncertainties regarding the renewal of the contract in 2026 in this area owned by TOKİ constitute negative factors for the sector and are seen as significant risks.

6.7.2. Economic

Economic structure, lack of capital and financing, high inflation pressure, economic slowdown and exchange rate fluctuations are of critical importance for the sector. Uncertainties brought by Covid-19 and its aftermath, high labour costs compared to South Asian countries, other countries paying high prices for scrap ships, and fluctuations in steel prices are among the issues that need to be focused on. The fact that Türkiye's CDS rate is around 400 constitutes a serious risk for facilities to find loans.

6.7.3. Sociological

Environmental awareness is widespread among the population, particularly in industrialized nations. The dangers of SR in terms of the environment and human health continue to be on the agenda. Even if the facilities serving in Türkiye carry out recycling in accordance with the rules, this issue, highly related to the environment and human health, will continue to come up on the agenda, and it will always be an important issue that needs to be responded for the SR sector.

6.7.4. Technological

Facilities in Türkiye employ better technology compared to South Asian countries. Strengthening the infrastructure by utilizing the technology of the modern century in the SR process will increase the productivity of work, material and personnel in SR operations. There are serious deficiencies in innovation, automation, transformation speed, and research and development activities in the sector.

6.7.5. Legal

The 'Ship Recycling Regulation', with date 08.03.2004 and no. 25396, published in the Turkish Official Gazette, is valid for the facilities performing SR operations in Türkiye. It is not expected that any new legal regulations or practices in the sector will be issued in the near future.

6.7.6. Environmental

A major issue is that there is not enough room to accommodate the expansion of Aliağa SR facilities. This situation leaves limited room for manoeuvre for the facilities in terms of capacity increase. Operations that do not comply with environmental legislation pose serious risks in terms of environment and occupational safety. High fines are imposed on facilities where such operations take place. The summary evaluation of the PESTLE analysis within the scope of SWOT is also shown in Table 12.

TABLE 12. Aliağa SR facilities PESTLE analysis.

External Factors	Impacts
Political	Potential sanctions Political uncertainties Uncertainty about land ownership
Economic	Lack of capital and financing Ship recycling at high cost compared to South and East Asian countries Economic structure (High inflation, Increasing pressure in workers' wages, Fluctuations in exchange rate Pandemic and post-pandemic uncertainties High labour wages compared to South Asian countries High price payments for scrap ships by other countries Fluctuations in steel prices
Sociological	Lack of communication with the press and the public Public pressure
Technological	Resistance to global technology developments (lack of technological infrastructure, lack of innovation, lack of R&D, lack of automation, lack of transformation speed)
Legal	Lack of government support (no government incentives, no incentives in workers' salaries)
Environmental	Operations that do not comply with environmental legislation Penalties for environmental pollution

6.8. Aliağa Ship Recycling Facilities Efficiency Root Cause Analysis

Due to the fact that the land of the SR facilities belongs to TOKİ, that the land is leased to the facilities for 20 years and that this period will expire in 2026, the facility owners do not prefer to make new investments in the existing production areas and increase the SR costs.

Due to the implementation of the Hong Kong Convention and the EU Ship Recycling Regulation, ship owners have to recycle their ships at SR facilities that comply with international rules. Apart from the investments they will make, the facilities should increase their OHS measures and implement safe operating procedures to comply with international regulations. In this regard, the facilities face extra costs.

To compensate for the increased costs, SR facilities need to increase their revenue from scrap ships or reduce their dismantling operation costs. Since market conditions prevail in the purchase of scrap ships and the sale of scrap steel, prices cannot be interfered with too much. However, the facilities may become more preferred by large companies and EU flagged ships by improving their SR processes. This will increase the productivity of the facilities as well as reduce their energy consumption and thus carbon emissions.

In this context, the problems affecting efficiency (productivity, steel scrap production) in Aliağa SR facilities were examined and the following parameters were obtained.

Facility Space Problems:

- Facility location
  - Facilities stuck in narrow space
  - Site planning deficiencies
  - Missing storage areas
- Transfer delays between terminals
  - Production site congestion
  - Weak site planning
  - Facility internal layout issues
- Distance between the cutting machinery used
  - Weak planning
  - Emission generation
- Storage areas
  - Slow sorting of products
  - Tardiness in external transport
  - Storage area congestion

Labour Problems:

- Personnel performance efficiency
  - Long working hours
  - Lack of a shift system
  - Lack of experience
  - Lack of training
  - Lack of coordination
  - lack of attention
  - Lack of control skills
- Lack of personnel motivation
  - Low wages
  - Socio-economic reasons
  - Heavy work conditions
  - Environmental factors
- Lack of qualified employees
  - Insufficient/deficient training
  - Lack of sense of belonging
  - Excessive work load

Dismantling Process Problems:

- Landing operations
  - Delays in towing the ship with the capstan system
  - Lack of engineers and engineering perspective
- Welding cutting
  - Slow cutting speeds
  - Fires in the work environment
  - Emissions
- Excessive / faulty cutting
  - Failure to meet part size requirements
- Cutting gear issues
  - Faulty planning
  - Faulty operation
- Lack/insufficiency of handling and transportation
  - Lack of cranes
  - Lack of polygrabs
  - Lack of transport trucks

Environmental and Occupational Health and Safety Risks:

- Fire and explosion risks
  - Presence of flammable materials
  - Presence of explosive materials
  - Presence of closed areas
  - Presence of toxic gases
- Frequent accidents
  - Lack of training
  - Lack of attention
  - Long working hours
- · Deficiencies regarding precautions
  - Lack of regulation
  - Lack of control

Material Problems:

- Equipment - malfunction problems
  - Lack of maintenance
  - Low quality
  - Old technology
- Oxy-propane welding
  - Low cutting rates
  - Length of installation time
  - Fire risk
- Trucks
  - Lack of capacity
  - Lack of availability
- Polygrab
  - Lack of operators
  - Lack of availability
  - Lack of capacity
- Cranes
  - Lack of operators
  - Lack of availability
  - Lack of capacity

6.9. Lean Six Sigma, Kaizen and Resilience Engineering Performance Evaluation

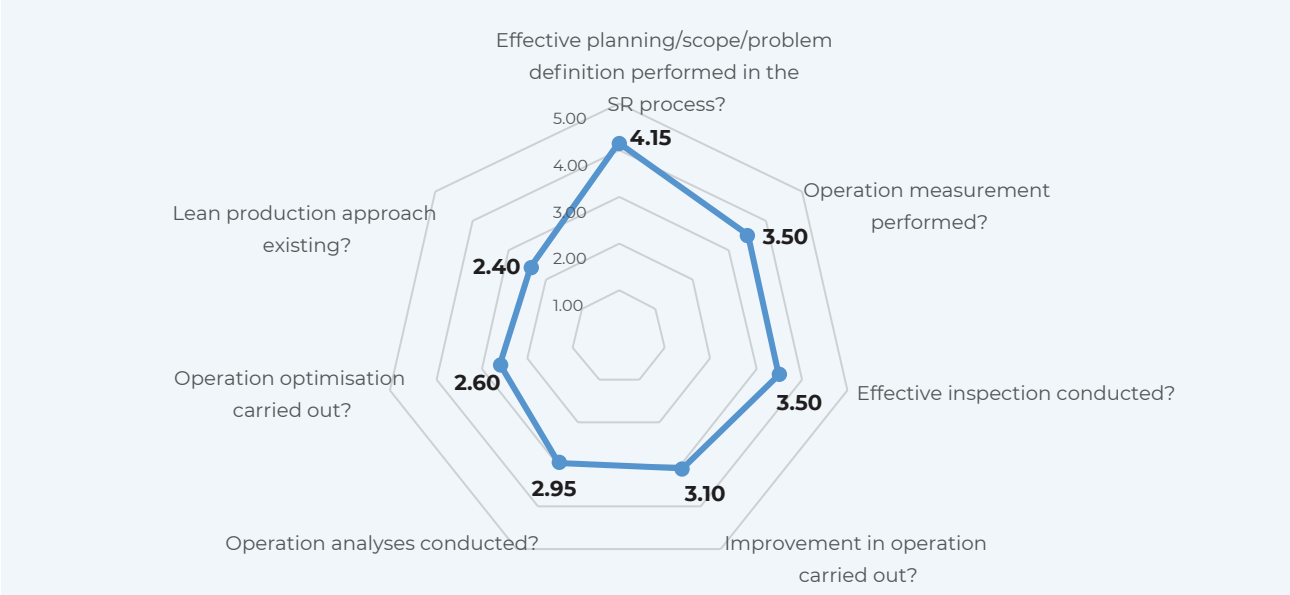
In this section, the factors affecting efficiency and productivity in İzmir Aliağa SR facilities will be evaluated using Lean Six Sigma, Kaizen Cycle and Resilience Engineering (RE) principles.

6.9.1. Six Sigma and Lean Six Sigma

Six Sigma is a management strategy in which convenient and effective statistical tools are used to ensure capacity development and excellence in business processes in companies. While Six Sigma focuses on reducing process variation and improving process control, Lean Six Sigma eliminates waste (non-value-added processes and procedures) and promotes business standardization and flow. Lean Six Sigma is a fact-and-data-driven improvement philosophy that values defect prevention over defect detection. It provides competitive advantage by reducing variation, waste and cycle time, promoting the use of business standardization and flow, and drives buyer satisfaction and results.

Lean Six Sigma evaluation of the shipbreaking process was carried out by telephone/e-mail/online meeting/face-to-face interviews and survey studies conducted in regards to Aliağa SR facilities. The average of the performance scores obtained by the evaluation of 20 experts was taken and shown in Figure 50. The scale (1: very low, 2: low, 3: moderate, 4: high, 5: very high) was used for assigning performance scores.

FIGURE 50. Aliağa SR facilities field operations Lean Six Sigma performance evaluation



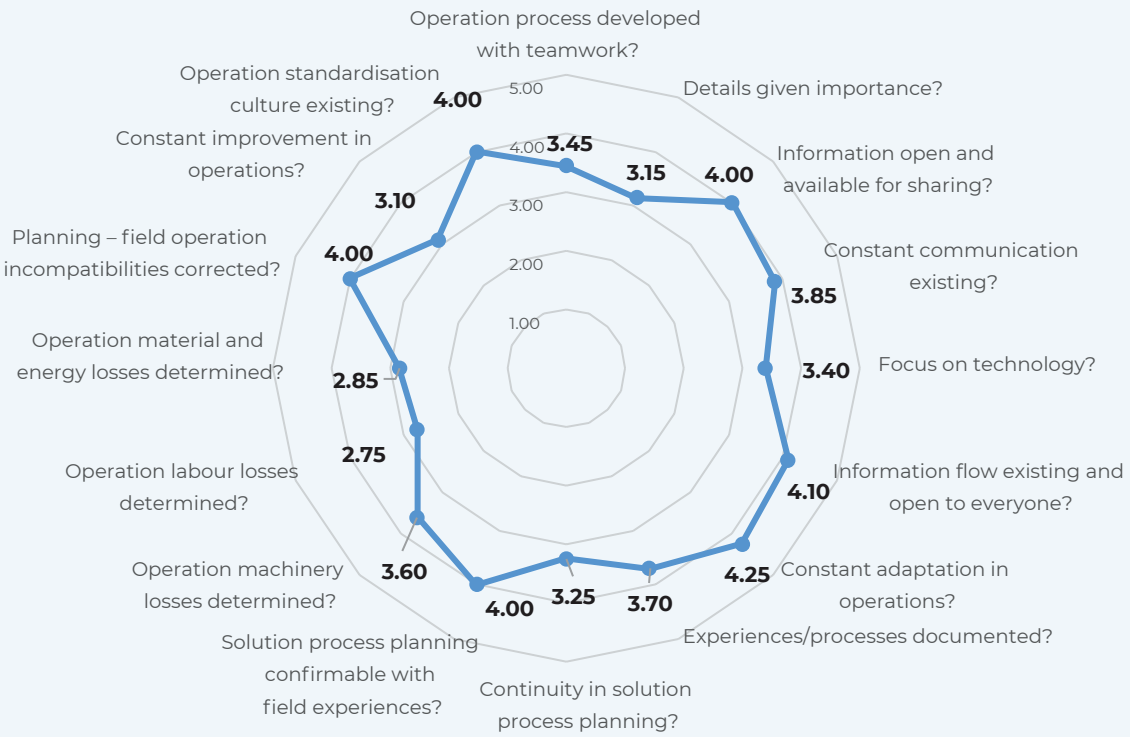
From the results obtained, it has been determined that the lean production culture is insufficient in Aliağa SR facilities, and the necessary sensitivity and studies on operation analysis and optimization are not carried out. Besides this, the performance scores of effective control processes, measurements and improvements in operations were calculated in the middle to good range (3.1 - 3.5). It has been observed that the facilities display a good level with a performance score of 4.15 in business planning, scope analysis and problem definition in the SR process.

6.9.2. Kaizen Cycle

Kaizen is a lean manufacturing tool that improves quality, productivity, safety and workplace culture. Kaizen comes from two Japanese words: Kai (improvement) and Zen (good), meaning "continuous improvement." In the business world, Kaizen refers to activities that continuously improve all functions and involve all employees.

Expert opinions were sought in the Kaizen Cycle performance evaluation of Aliağa SR facilities. The average of the performance scores obtained from 20 experts is shown in Figure 51. In the assignment of performance scores, the scale indicating 1: very low, 2: low, 3: moderate, 4: high, 5: very high was used.

FIGURE 51. Aliağa SR facilities operational process Kaizen performance evaluation



Critical elements in Kaizen assessment with below-medium or near-medium performance scores are found to be as follows:

- Determination of operational workforce losses (2.75)
- Determination of operational material and energy losses (2.85)
- Continuous improvement in operations (3.10)
- Giving attention to details (3.15)
- Focus on technology (3.40)
- Solution process planning continuity (3.45)

Thus it is seen that such factors should be improved first in order to increase the operational efficiency of the facilities.

6.9.3. Resilience Engineering and Principles

Resilience engineering (RE) may be expressed as a new safety management paradigm compatible with the nature of complex socio-technical systems. RE offers a new perspective to control events and limit their consequences.

In this section, RE principles affecting efficiency and productivity in Aliağa SR facilities are examined. Initially, RE principles were determined through extensive literature reviews, and then performance scores of these principles were obtained through expert opinions. RE performance scores obtained through the questionnaires are shown in Appendix F. In the evaluation of performance scores the scale indicating 1: very low, 2: low, 3: moderate, 4: high, 5: very high was used. RE principles performance values obtained through 20 expert opinions are shown in Figure 52 and Figure 65.

Among the investigated RE principles, performance values are expected to be four and above for those with benefit type, while it is expected to be two or less for those with cost type. If the preferability of a factor (principle) increases as its value increases, the benefit type is the criterion, and in the opposite case, the cost type is the criterion. It is recommended to make improvements primarily in the benefit-type RE principles with a performance score below three and the cost-type RE principles with a performance score above four.

RE principles affecting efficiency and productivity in Aliağa SR facilities are examined under the following headings.

Top management commitment

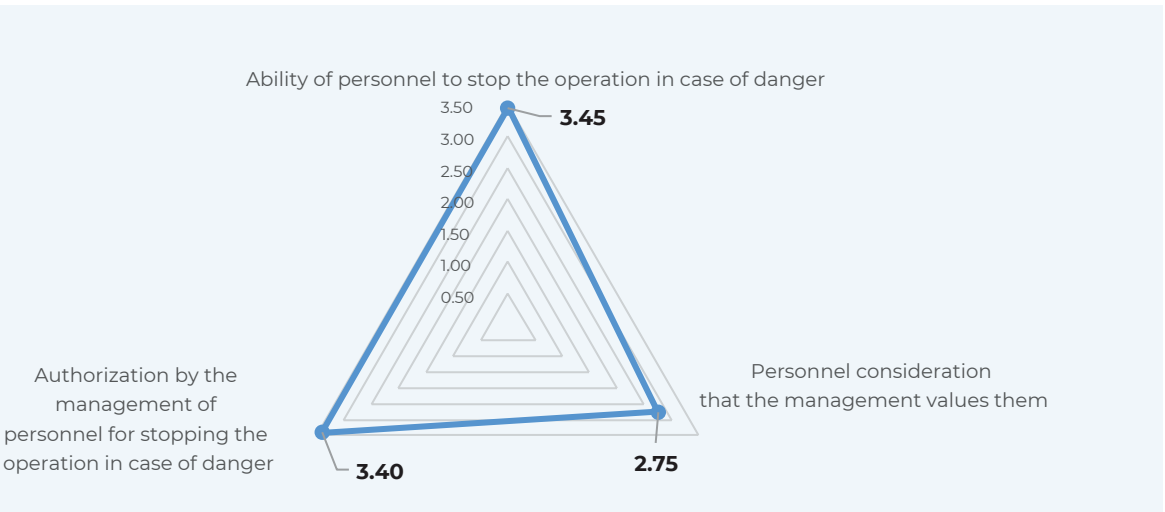
- Reporting culture
- Learning and feedback
- Awareness
- Readiness
- Being flexible
- Backups
- Job satisfaction
- Work stress
- Work pressure
- Rewarding
- Job burnout
- Work autonomy, control and authority
- Goals

Under the evaluation of the RE principle **"top management commitment",** the following benefit type factors were evaluated;

- Ability of personnel to stop the operation in case of danger
- Personnel consideration that the management values them
- Authorization by the management of personnel for stopping the operation in case of danger

Herein it is observed that all RE factors have values below 4. In particular, a value of 2.75 was found for the factor "personnel consideration that the management values them", which is below the medium, which will cause the personnel working in the facilities to not feel a sense of belonging and will lead to the risk of not failure to ensure personnel continuity (Figure 52).

FIGURE 52. Top management commitment principle

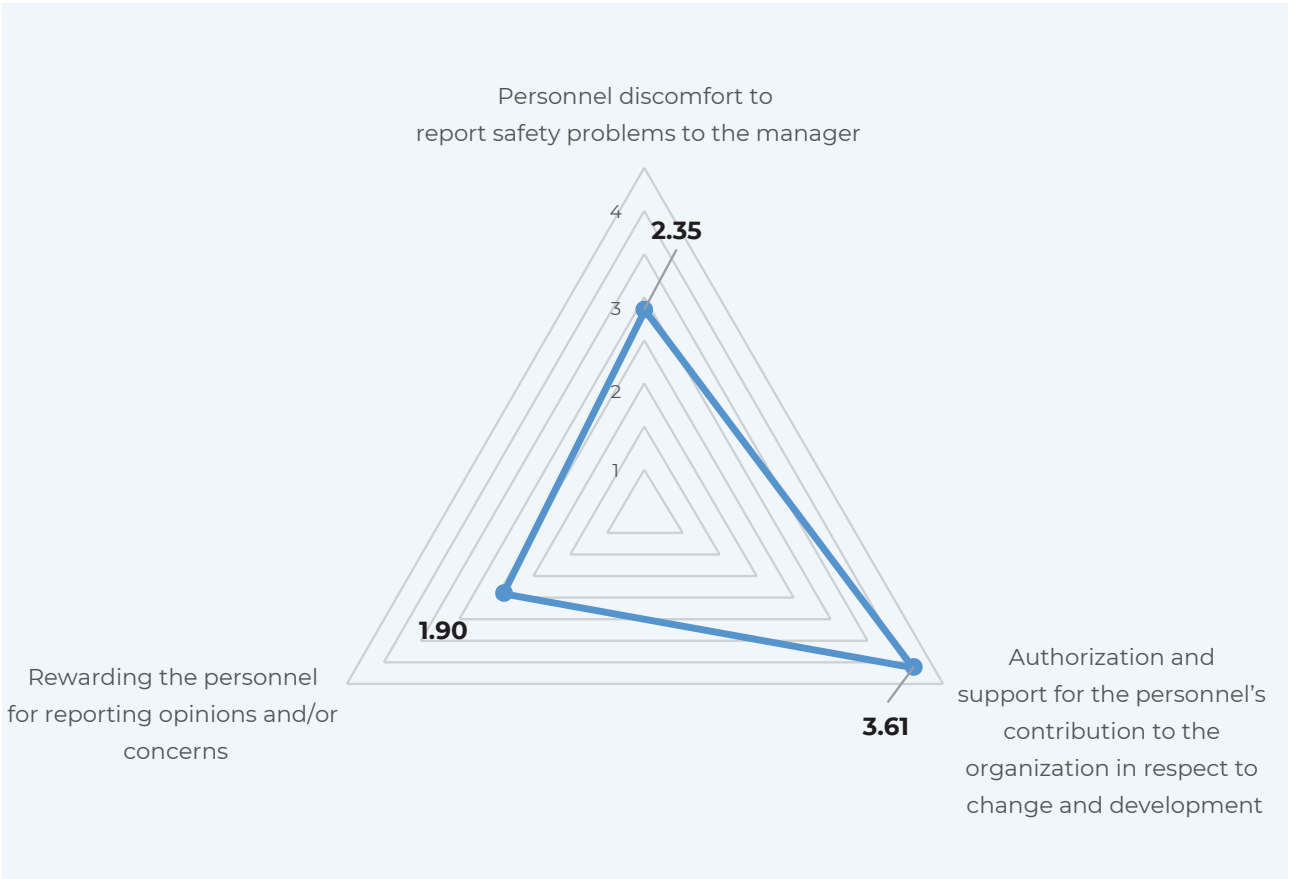


Under the evaluation of the RE principle **"reporting culture",** the following factors were utilized (Figure 53);

- Personnel discomfort to report safety problems to the manager
- Authorization and support for the personnel's contribution to the organization with respect to change and development
- Rewarding the personnel for reporting opinions and/or concerns (e.g. safety related)

"Personnel discomfort to report safety problems to the manager" is a cost-type factor and is required to be kept below 2. The low value found as 2.15 indicates that the personnel have concerns in this field, although small. The other two factors are benefit type RE factors, among which "Rewarding the personnel for reporting opinions and/or concerns (e.g. safety related) coming up with a low value of 1.90 will lead to a lack of sense of belonging of the personnel and thus to personnel discontinuity. "Authorization and support for the personnel's contribution to the organization in respect to change and development" is also a benefit type RE factor, with a performance value found to be 3.61, and thus above medium.

FIGURE 53. Reporting culture principle

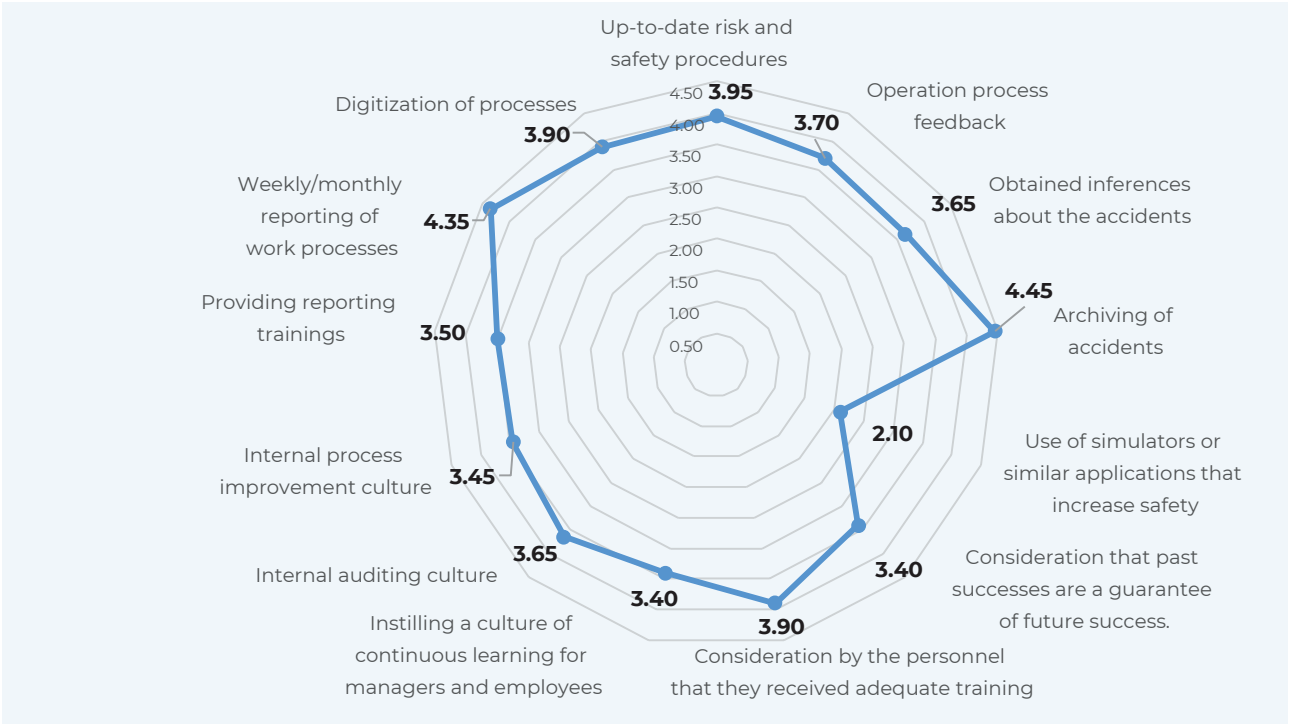


The factors utilized for the evaluation of the RE principle **"Learning and feedback"** are as follows:

- Up-to-date risk and safety procedures
- Operation process feedback
- Obtained inferences about the accidents
- Archiving of accidents
- Use of simulators or similar applications that increase safety
- Consideration that past successes are a guarantee of future success,
- Consideration by the personnel that they received adequate training
- Instilling a culture of continuous learning for managers and employees
- Internal auditing culture
- Internal process improvement culture
- Providing reporting trainings
- Weekly/monthly reporting of work processes
- Digitization of processes

Factors and performance values related to the RE principle "Learning and Feedback" are shown in Figure 54. "Consideration that past successes are a guarantee of future success" and "Consideration by the personnel that they received adequate training" are cost-type factors, unlike others. While performance scores should be below 2, the received scores of 3.4 and 3.9, respectively, will increase the risk of making mistakes for the personnel. From the evaluations made for other RE factors, it has been observed that "Instilling a culture of continuous learning for managers and employees" is not fully mature, and that there are serious deficiencies in "Use of simulators or similar applications that increase safety" factor. The use of simulator etc. techniques in modern industry companies has proven to be quite successful in terms of observing the nature of the job without experiencing it and gaining the habit of proactive approach. The fact that the performance values of the factors "Up-to-date risk and safety procedures", "Operation process feedback", "Inferences obtained from the accidents", "Internal audit culture", "Internal process improvement culture", "Providing reporting trainings" and "Digitalization of processes" are in the range of 3.5-4.0 indicates that there is a certain awareness about "Learning and Feedback", but more actions are needed to be taken in order to increase and maintain this culture in the facilities.

FIGURE 54. Learning and feedback culture principle



The factors utilized for the evaluation of the RE principle **“Awareness”** are as follows:

- Seeing the company's capability to achieve multiple goals at the same time (safety, costs, production etc.)
- Strictly following the guidelines
- All employees know the safety issues in the facility
- Knowing what is happening in the facility
- Presence of occupational health and safety trainings
- Frequency of occupational health and safety trainings

Among the findings, “All employees knowing the safety issues in the facility” got a near¬-medium score of 3.20 (Figure 55). Due to the nature of the work, a much higher level to be achieved in this factor will be important to increase plant safety. The “strictly following the guidelines” factor is also rated at 3.25. In order for the operational process and safety requirements to be carried out correctly, actions should be carried out to have this culture embraced by the personnel. The performance value of 3.6 found for the “frequency of occupational health and safety trainings” is not sufficient for the SR sector, which bears too many inherent risks.

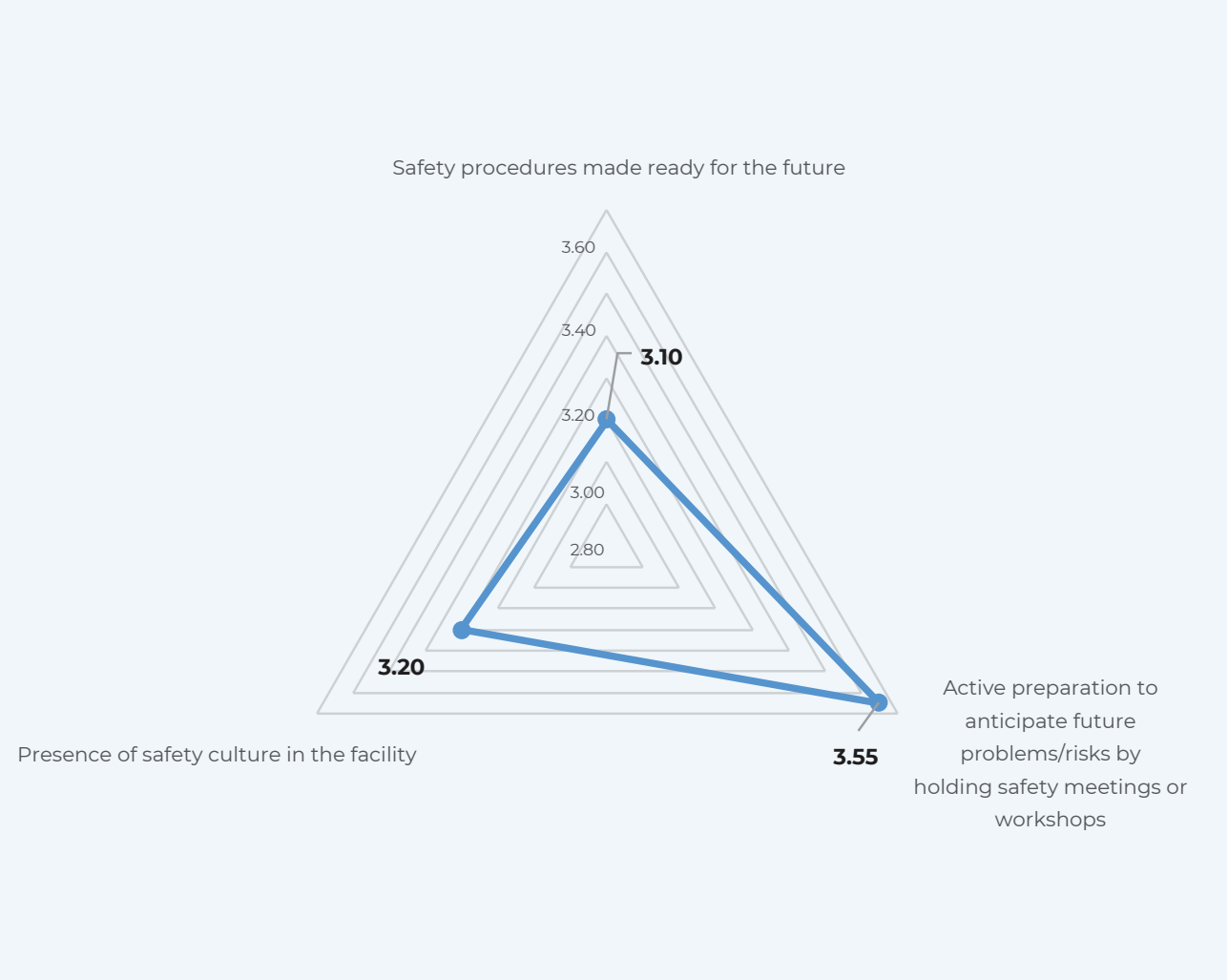
FIGURE 55. Awareness principle

The following benefit type factors (Figure 56) were utilized for the evaluation of the RE principle **"Preparation";**

- Safety procedures made ready for the future
- Active preparation to anticipate future problems/ risks by holding safety meetings or workshops
- Presence of safety culture in the facility

At this stage it is found to be likewise worrying that the answers given to the questions "Safety procedures made ready for the future " and "Presence of safety culture in the facility" occur to be at moderate levels. A performance value of 3.55 was calculated, between medium and high, for "Active preparation to anticipate future problems/risks by holding safety meetings or workshops". It is necessary to give priority to the realization of all kinds of activities towards effectively spreading the lifelong learning culture and proactive thinking system to every stage of management and production in the facilities and keeping it alive.

FIGURE 56. Preparation principle

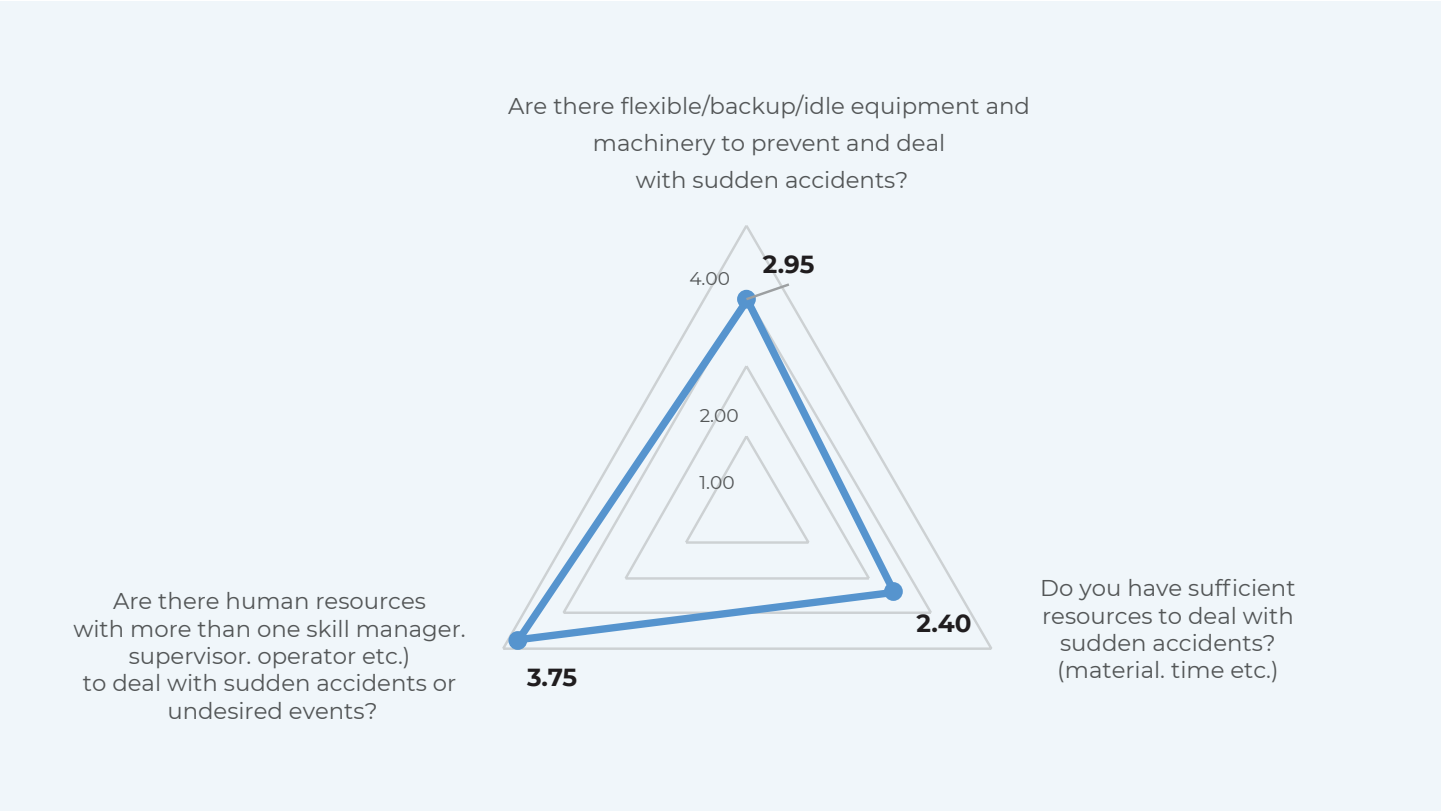


The following benefit type factors (Figure 57) were utilized for the evaluation of the RE principle **“Flexibility”;**

- Are there flexible/backup/idle equipment and machinery to prevent and deal with sudden accidents?
- Do you have sufficient resources to deal with sudden accidents? (material, time etc.)
- Are there human resources with more than one skill (manager, supervisor, operator etc.) to deal with sudden accidents or undesired events?

The fact that performance scores of the factors “Do you have sufficient resources to deal with sudden accidents? (material, time etc.)” and “Are there flexible/backup/idle equipment and machinery to prevent and deal with sudden accidents” are found to be 2.4 and 2.95 respectively indicates that facilities need to work harder to improve safety.

FIGURE 57. Flexibility principle

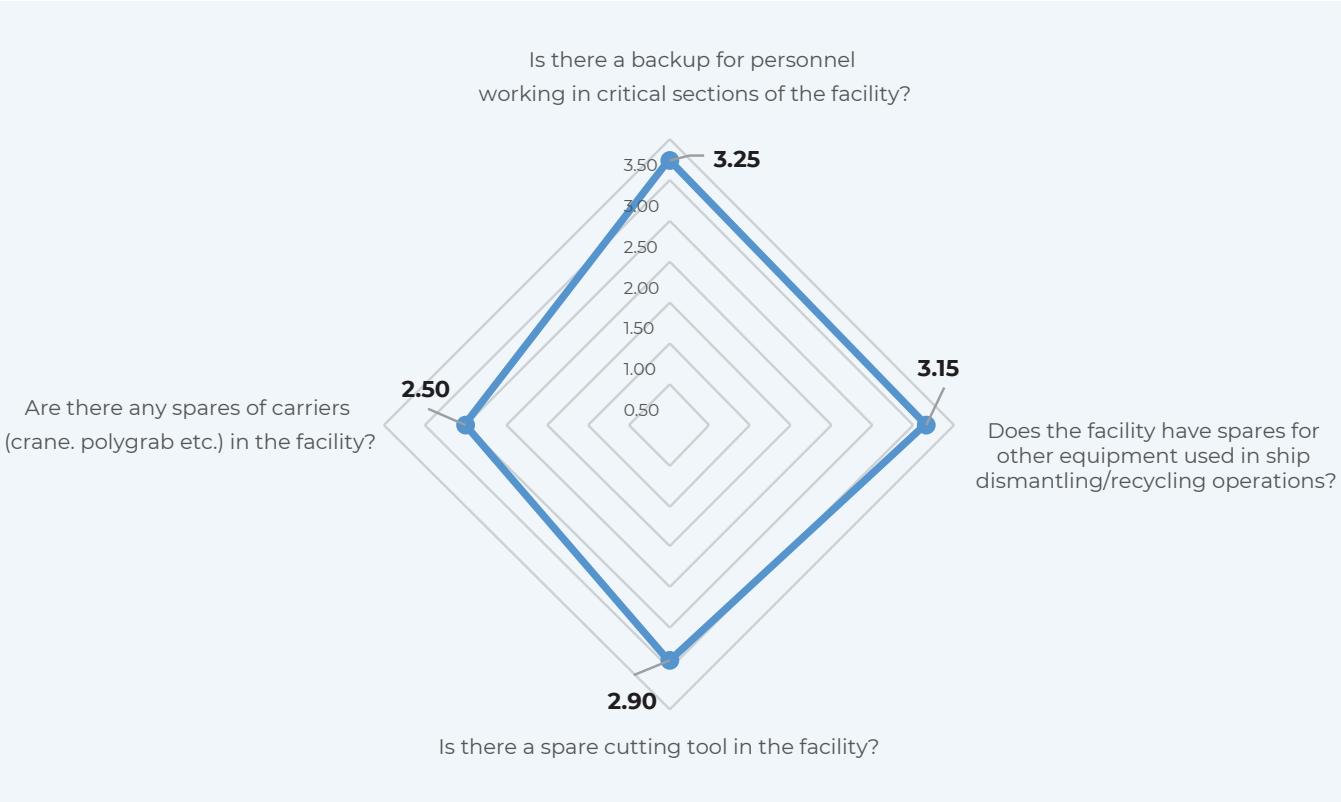


The following benefit type factors (Figure 58) were utilized for the evaluation of the RE principle **“Backups”;**

- ·Is there a backup for personnel working in critical sections of the facility?
- ·Does the facility have spares for other equipment used in ship dismantling/recycling operations?
- ·Is there a spare cutting tool in the facility?
- ·Are there any spares of carriers (crane, polygrab etc.) in the facility?

The examination of the answers given reveals that the critical questions of “Is there a spare cutting tool in the facility” and “Are there any spares of carriers (crane, polygrab etc.) in the facility?” were answered to reflect performance scores that are below medium. Also, “Is there a backup for personnel working in critical sections of the facility?” and “Does the facility have spares for other equipment used in ship dismantling/recycling operations?” questions reveal values of 3.25 and 3.15, respectively, displaying a performance slightly above the medium level. Since the SR dismantling process must take place within a certain time frame and in a safe manner, it is recommended to develop strategies for determining and backing up critical personnel/equipment/cutting tools/carriers of which absence will endanger the operations.

FIGURE 58. Backups principle

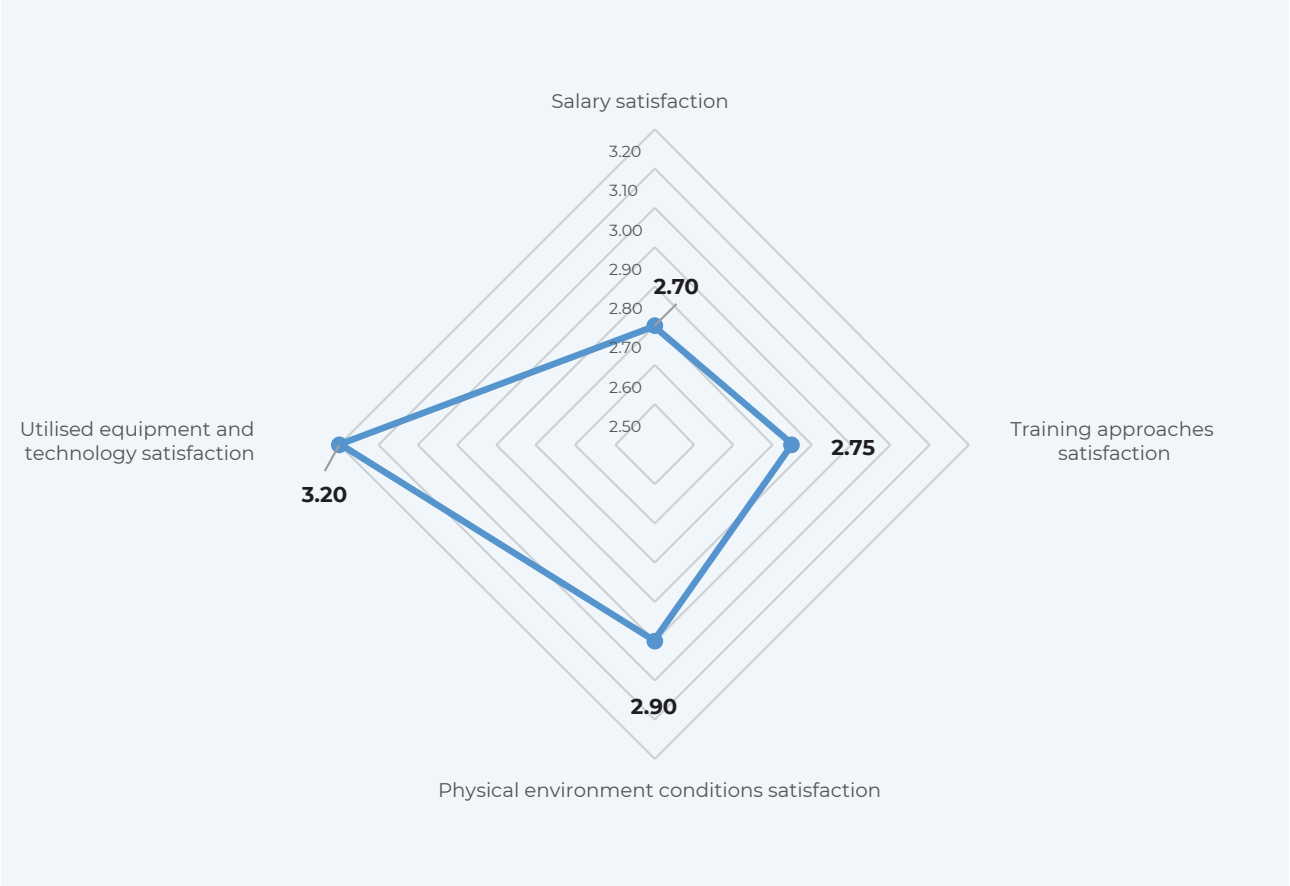


The following benefit type factors (Figure 59) were utilized for the evaluation of the RE principle **"Job satisfaction";**

- How well does your salary meet your needs?
- To what extent are you satisfied with the training approaches in the company?
- Are you satisfied with the physical conditions of your workplace (heat, light, environment, location, ventilation etc.)?
- How satisfied are you with the equipment and technology you use?

Job satisfaction is one of the main factors in human resource management. From the evaluations obtained, it may be mentioned that there is a general dissatisfaction with the facilities. Salary, training approaches and workplace physical conditions performance values remained below the medium level. Satisfaction with the equipment and technology used is also slightly above the medium level. It is recommended to carry out actions to increase job satisfaction for the sense of belonging and business continuity of the personnel.

FIGURE 59. Job satisfaction principle

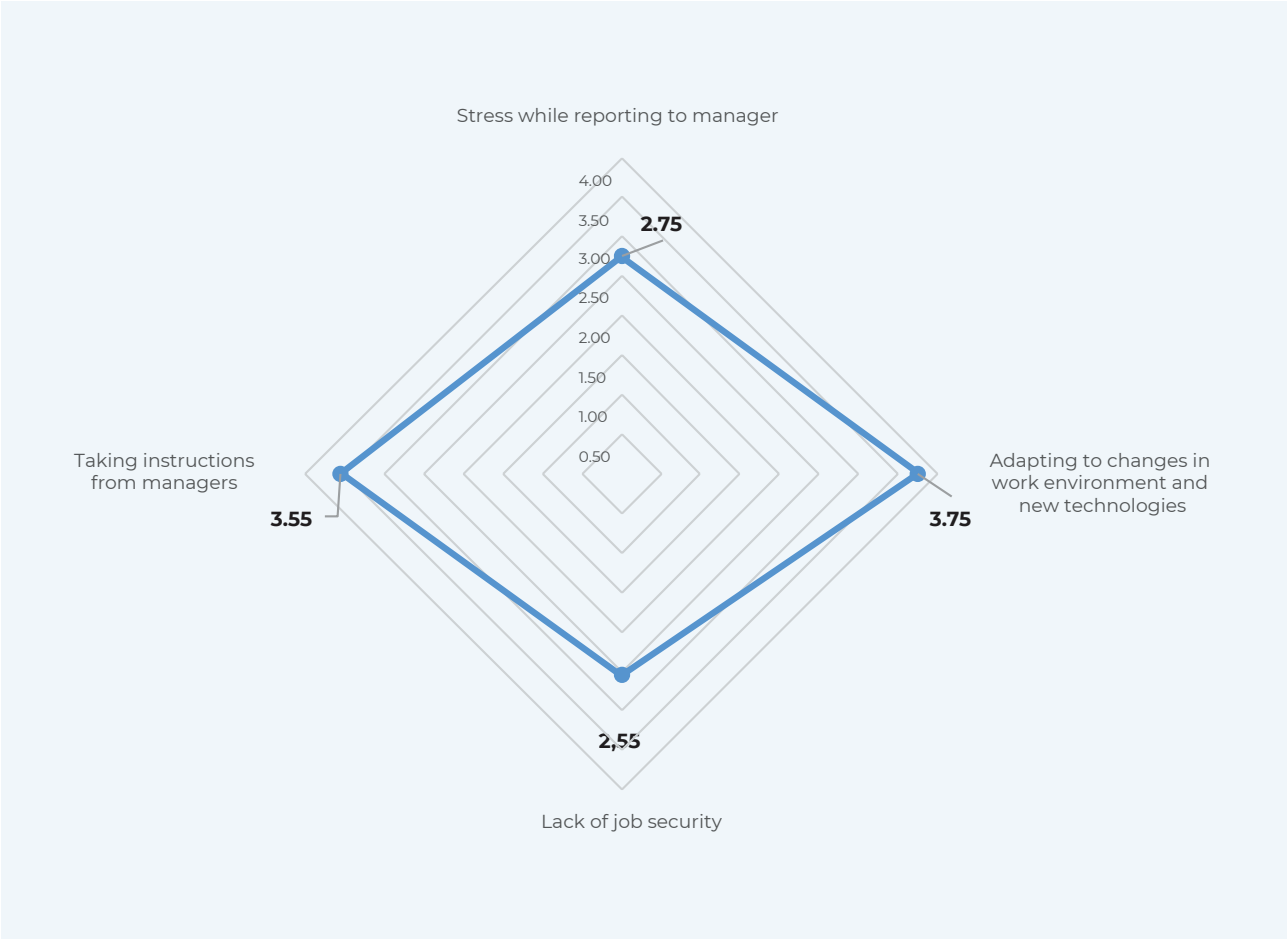


The following factors (Figure 60) were utilized for the evaluation of the RE principle **“Work Stress”;**

- Do you experience any stress while reporting to your manager?
- How well do you adapt to changes in your work environment and new technologies?
- To what extent do you experience the feeling of lack of job security?
- Do you take all the instructions from your managers in your work?

Work stress affects the normal performance of employees and causes a decrease in productivity and is an important factor that hinders employee continuity, leading to loss of productivity. Of the four factors used here, contrary to other factors, it is desirable that the performance score for the question “Do you experience any stress while reporting to your manager?” is low (2 and below), since it is a cost type factor. The 2.75 value obtained indicates the existence of moderate stress for the personnel. The value of 2.55 obtained in consideration of the answers to the question “To what extent do you experience the feeling of lack of job security?” indicates the existence of a medium level threat of job loss originating from the top management.

FIGURE 60. Work stress

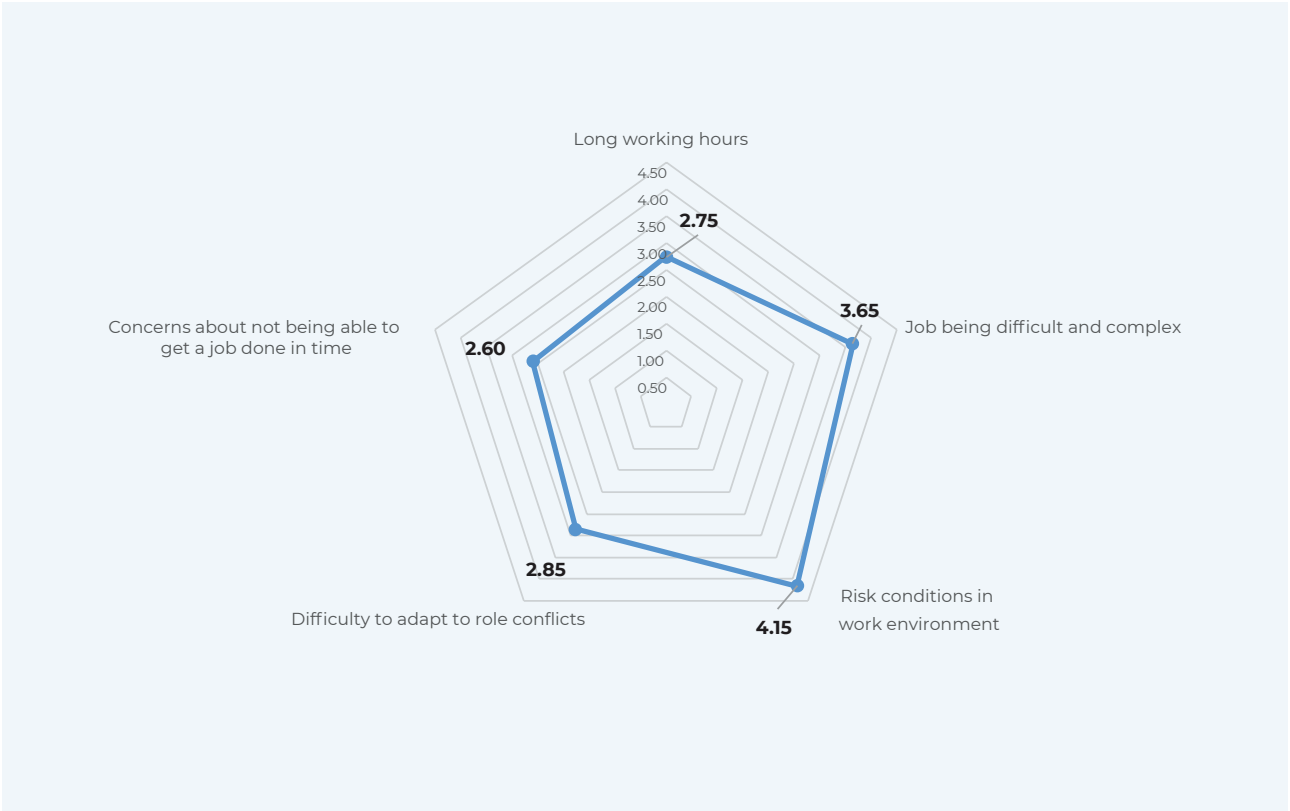


In the evaluation of the RE principle **"Work Pressure",** the following factors (Figure 61) were utilized;

- Do you complain about long working hours?
- To what extent do you consider your job difficult and complex?
- Do you think there are risk conditions (physical or mental) in your work environment?
- Do you find it difficult to adapt to role conflicts (expectations on matters other than the personnel's job)?
- Do you have any concerns about not being able to get a job done in time?

Everything in this case is a cost-type factor and performance values are expected to be below 2, while the range of 2.60-4.15 obtained clearly reveals work pressure on the personnel. One solution could be for facilities to use simulators that can visually model the shipbreaking process to relieve the stress/pressure on personnel. In this way, the personnel can develop strategies that will reduce the difficulty/complexity of the process by performing the operational process in question through the simulator and thus reduce the pressure on them. In addition, bottlenecks/risks/difficulties that may be experienced may be identified by following the shipbreaking process, and thus efficiency-enhancing and risk-reducing activities can be carried out. In addition, shortening the working times of the personnel / switching to a shift working system will increase the productivity of the personnel.

FIGURE 61. Work pressure

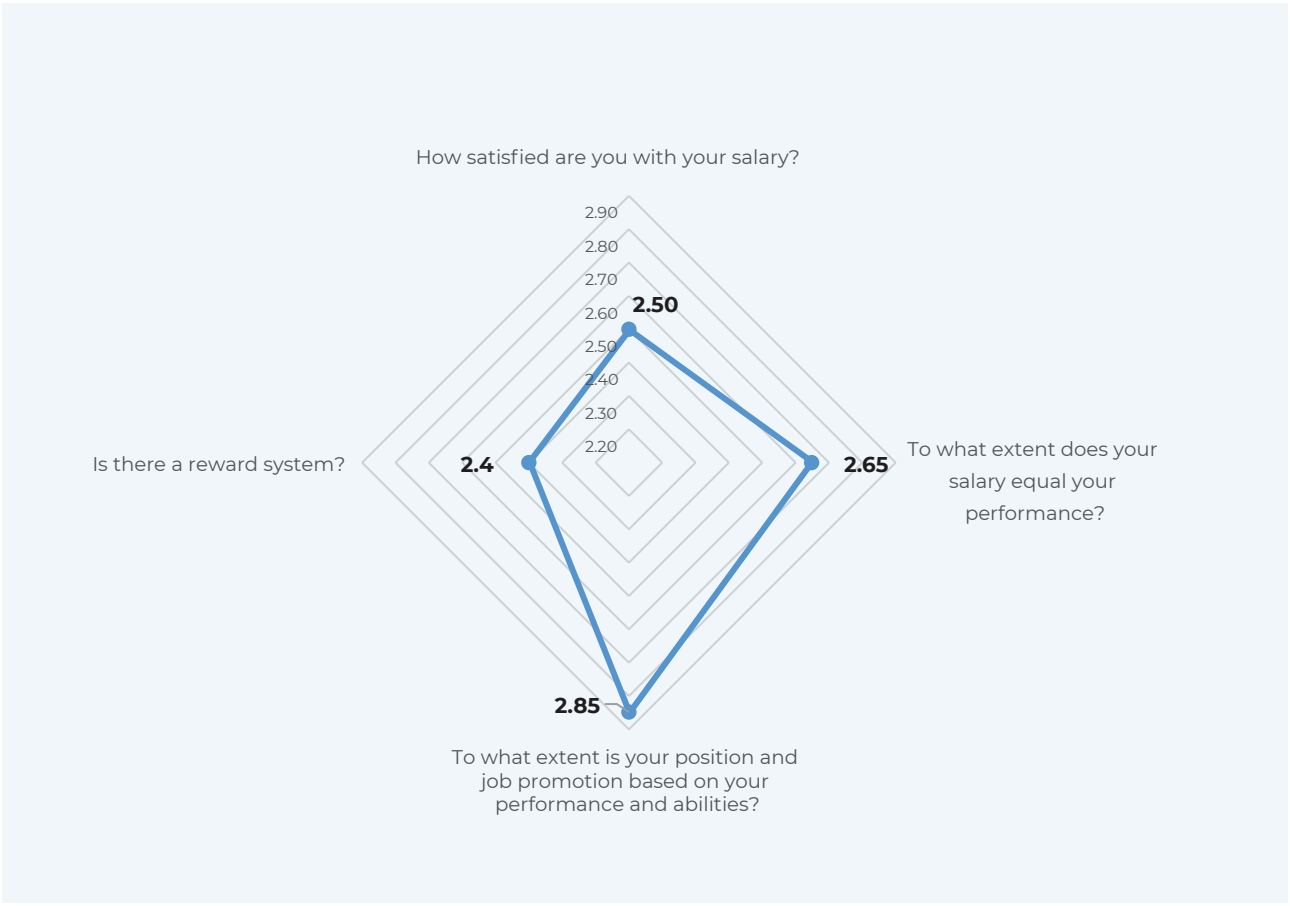


The following benefit type factors (Figure 62) were utilized for the evaluation of the RE principle **“Rewarding”;**

- How satisfied are you with your salary?
- To what extent does your salary equal your performance?
- To what extent is your position and job promotion based on your performance and abilities?
- Is there a reward system?

The answers to the questions asked about the issues that are thought to enable the employees at SR facilities to show high performance and improve themselves were found to display performance scores below the medium level. SR facility owners should develop strategies on “Rewarding” in order to increase the motivation of their employees, increase efficiency and achieve facility goals.

FIGURE 62. Rewarding principle

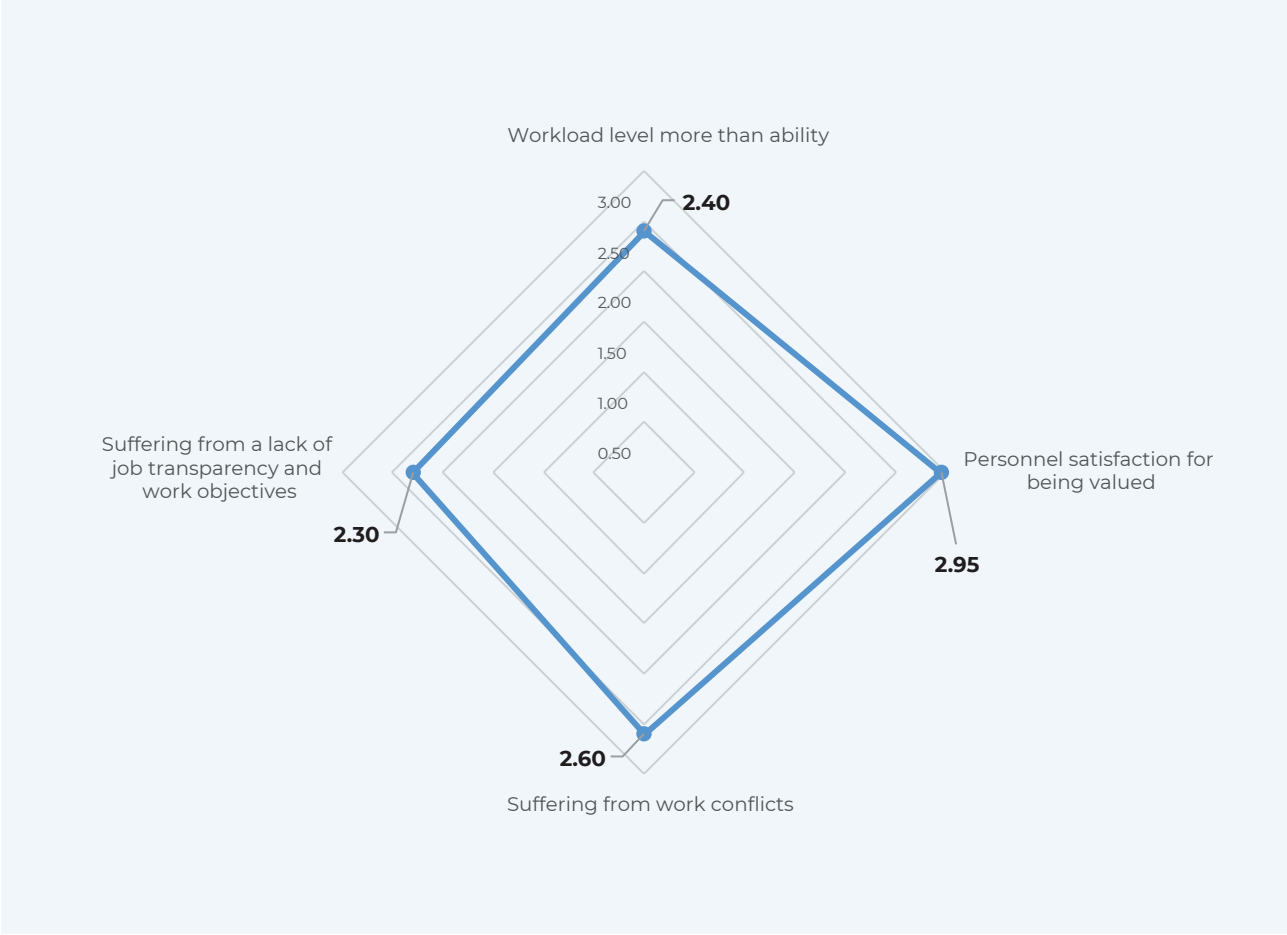


In the evaluation of the RE principle **"Job Burnout",** the following factors (Figure 63) were utilized;

- Do you think the level of workload is more than your ability?
- Do you think managers value your work and your ideas/comments (importance satisfaction)?
- To what extent do you suffer from work conflicts?
- To what extent do you suffer from a lack of job transparency and business objectives?

The performance values of cost-type factors, "Do you think the level of workload is more than your ability", "To what extent do you suffer from a lack of job transparency and business objectives?" and "To what extent do you suffer from work conflicts?", that should be below 2.0 were measured in the range of 2.30-2.60. This shows that the personnel have concerns about these issues. The value of 2.95 that was obtained for the benefit-type factor, "Do you think managers value your work and your ideas/comments", highlights a situation that will negatively affect the long-term work plans and productivity of the employees at the relevant SR facilities.

FIGURE 63. Job burnout principle

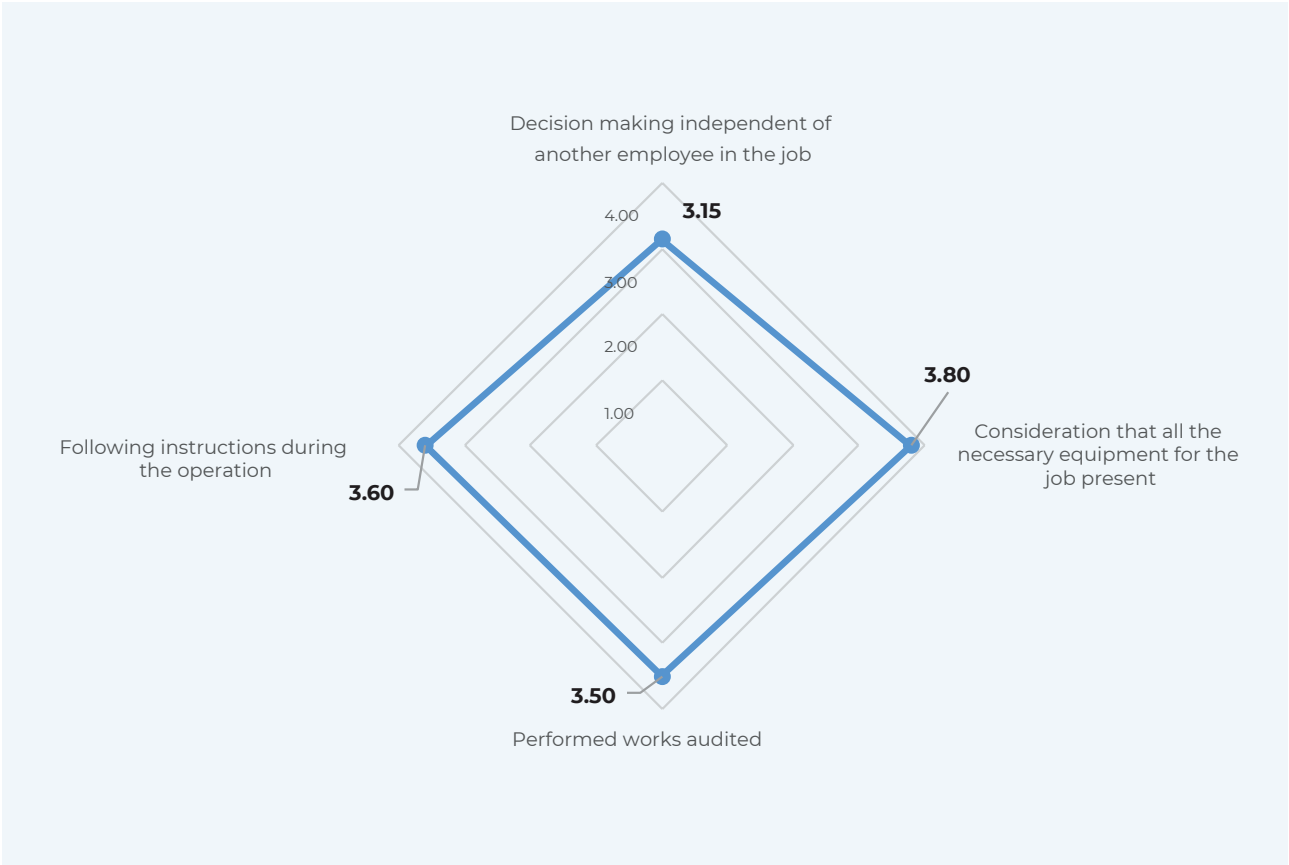


In the evaluation of the RE principle **"Work Autonomy, Control and Authority"**, the following factors (Figure 64) were utilized;

- Do you think that you can make decisions independently of another employee or supervisor in your job?
- Do you think you have all the necessary equipment for the job?
- Is your work audited?
- Do you follow the instructions during the operation?

"Do you think you have all the necessary equipment for the job?" and "Do you think that you can make decisions independently of another employee or supervisor in your job?" are cost-type factors and should be focused on as they have performance values of 3.80 and 3.15, respectively. Excessive self-confidence of the staff, thinking that they are good in their profession, or making unsupervised independent decisions may cause mistakes. "Do you follow the instructions during the operation?" and "Is your work audited?" are benefit-type factors and are observed to have values of 3.6 and 3.5, respectively. In order to increase the resilience level of the facilities and obtain resilient systems/operations/facilities, it is absolutely necessary to have audits realized by a superior mind, especially during the operation process and in cases that constitute a risk. In order to increase these RE factors to the above middle levels of 4 and above, the necessary culture should be established.

FIGURE 64. Work autonomy, control and authority principle

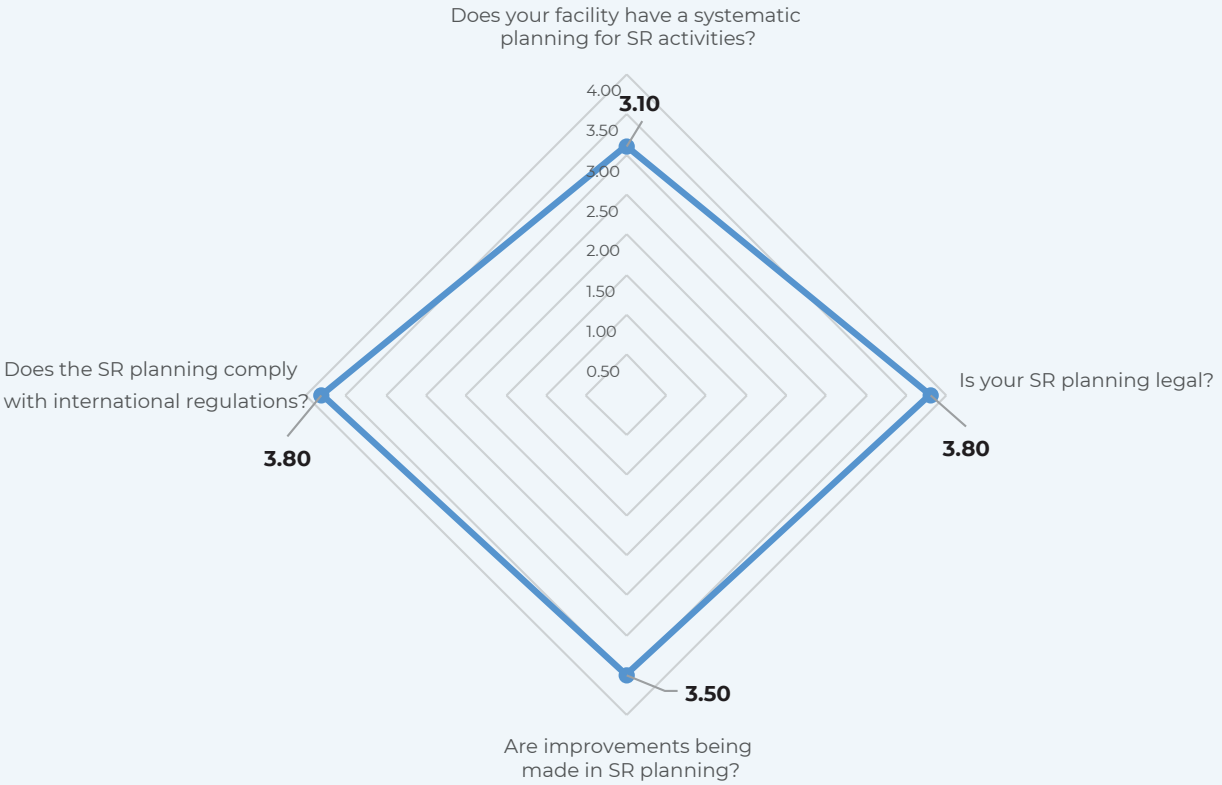


The following benefit type factors (Figure 65) were utilized for the evaluation of the RE principle 'Goals';

- Does your facility have systematic planning for SR activities?
- Is your SR planning legal?
- Are improvements being made in SR planning?
- Does the SR planning comply with international regulations?

The medium level performance score of 3.25 that was obtained with respect to the question of "Does your facility have a systematic planning for SR activities?" indicates that more actions are needed to be realized towards productivity. A value of 3.55 concerning the factor "Are improvements being made to SR planning?" indicates the lack of a proactive thinking system. A value of 3.8 is a good value above the average for the compliance of SR planning with national and international regulations, and this rate will increase even more in the process preparations for the facilities continuing their activities in Aliağa to be included in the EU Commission Ship Recycling List.

FIGURE 65. Goals principle



6.10. Conclusion and Evaluation

In this section, SWOT, Pareto, PESTLE, Kaizen, Lean Six Sigma and Five Forces Analysis studies were carried out to determine the factors that create value for SR facilities continuing their activities in İzmir Aliağa District. During the study, questions about the critical building blocks of these methods were asked to the experts in the sector, and the results and evaluations were examined in detail in the relevant sections. Furthermore, the resilience of the sector was also evaluated in the study. In this context, RE principles were determined, effective factors under these principles were revealed, and the performance of the sector under these principles and factors was attempted to be determined.

Studies illustrate that there is still a long way to go, especially regarding RE. There are many weak points observed such as the sector's reactive (traditional, passive) approaches to production/personnel/technology/globalism issues, investment deficiencies due to property problems, economic structure, public pressure, lack of efficiency in the field etc.

However, Aliağa SR sector also has strengths or opportunities such as Türkiye's environmental friendly shipbreaking in accordance with national and international legislation, the fact that it has entered the EU list with the highest number of facilities, its geographical location in Europe, the high demand for scrap steel, and willingness of more ship owners to scrap their ships due to Covid-19, and the increase in the number of ships arriving at the facilities etc.

CHAPTER 7.
Upgrade Plan

In this section, suggestions are developed to improve the problem areas identified as a result of the analyses carried out in regards to İzmir Aliağa SR facilities. Literature reviews, Aliağa facility visits, field interviews and experienced expert opinions obtained from the sector were used in the preparation of this set of recommendations, which is called the upgrade plan.

Existing problems are discussed under the following six main titles:

- Physical Infrastructure
- Machinery Equipment and Technology
- Knowledge and Experience
- Human Resources
- Financial Resources
- Suppliers, Industry Players and Public Relations Network

In the following sections, the topics of current main problems and sub-problems of the sector within the context of these titles, the possible causes of these problems, and the proposed upgrade plans in terms of budget and time dimensions against such problems are taken under examination.

7.1. Physical Infrastructure

Problem areas identified under the physical infrastructure are listed below.

- Existing Facility Area Expansion Problem
- Facility Area Ownership Problem
- Inefficient Use of Existing Facility Areas
- Lack of Inventory Management
- Absence of Dry-Dock
- Reusable Material Stock Area
- External Transport Issues

Upgrade plans were evaluated one by one based on these problem areas.

7.1.1. Existing Facility Area Expansion Problem

Definition: Lack of expansion opportunity along the existing shoreline for the 22 SR facilities serving at the area

Potential Cause: EGEGAZ and TÜPRAŞ refinery are located in the north, PETKİM and NEMRUT port complex are located in the south of the coastline where SR facilities are located, and TOTAL and EGEGAZ facilities are located within the property boundaries between Taşlı Cape and Ilıca Cape.

Upgrade Plan: Even if there are no expansion opportunities along the coast, it is considered that the land purchase opportunities that TOKİ can put up for sale in close proximity to the facilities should be considered. These areas can be used for product storage, stock management or for the transportation of personnel offices that do not take an active role in the operation. Thus, new arrangements can be made in the existing spaces of the facility, bringing operational efficiency to the fore.

Budget: Depends on the location and size of the lands that will expand the space available for the facilities.

Time: The date and duration are uncertain as there is no clarity on the sale of the land.

7.1.2. Facility Area Ownership Problem

Definition: The parcels on which 22 SR facilities operate not belong to them.

Potential Cause: The ownership of the area where the SR facilities are established belongs to TOKİ and this area is leased by TOKİ to the facilities.

Upgrade Plan: A 20-year lease agreement was signed with TOKİ in 2006 and will expire in 2026. The lease agreement made with TOKİ includes the article "After the expiration of the contract period, the leased areas will be taken back at the delivered location (empty)". In addition, TOKİ has the right to unilaterally terminate the usage right of this leased area without waiting for the expiry of the contract period.

SR facility owners do not want to invest in the region as the lease term is coming to an end and TOKİ does not give clear information about the future process. In addition, in order to make significant investment, it is requested that the lands be sold to them or the rental period should be increased from 20 to 49 years. The sale of these areas, which are used for production, to the facility owners by TOKİ under suitable conditions will contribute to the solution of the problem. Such a transaction that will aid the promotion of permanent investments of the facilities and the development of the sector is at TOKİ's disposal and there is no legal obstacle for the sale. It is considered that lobbying efforts to be carried out in this regard will be fruitful.

Budget: Depends on the location and size of the area to be rented or purchased.

Time: The date and duration are uncertain as it depends on the process to be carried out with TOKİ.

7.1.3. Inefficient Use of Existing Facility Areas

Definition: Companies with higher facility areas performing recycling operations at lower capacities according to the data.

Potential Cause: Absence of field efficiency optimization studies or insufficient realization of such studies, lack of SR process efficiency studies, human, technology, management deficiencies, insufficient shore length for the facilities.

Upgrade Plan: Modelling and optimizing actions to be performed for the existing shipbreaking sites by the companies over simulation studies will increase efficiency. When the area and annual production capacities of the existing facilities are examined, it is observed that Öge Gemi Sokum facility site has the most efficient use, while the Kılıçlar Geri Donusumlu Maddeler site has the least efficient use. It is considered that it would be beneficial to examine the underlying causes on the basis of facilities, and to develop strategies for possible causes (insufficient shoreline length, job, human, technology or management related deficiencies etc.). Studies to be carried out in this direction will benefit more efficient field use and more ship dismantling.

Budget: 40 - 50 thousand USD

Time: 12-18 months

7.1.4. Lack of Inventory Management

Definition: Lack of a strong inventory management, program and process in respect to the second-hand products obtained in the SR operations performed at the facilities.

Potential Cause: Lack of infrastructure and personnel.

Upgrade Plan: During the dismantling and recycling of ships, various products can be obtained to be sold in the second-hand market. While some of them find buyers quickly, some of them either kept scattered in the facilities or are broken up and sold as scrap material by the facility management. An effective inventory planning, management and automation system will provide a serious advantage for instant knowledge of product stocks and sales. The general trend in the facilities was determined to be that the material with second-hand value is kept in the field until the ship is dismantled and the unsold material is then sent to the scrap as soon as the dismantling is completed. Very valuable materials can be found and sold while they are still on the ship.

Budget: Inventory system setup on the basis of facility 15-20 thousand USD

Time: 6-9 months to set up, 12-18 months to establish inventory entry and continuity infrastructure

7.1.5. Absence of Dry-Dock

Definition: Lack of a dry-dock, the fact landing type shipbreaking method not provide a fully environment-friendly recycling operation, and the process of pulling the ship to the shore with capstans causing loss of time.

Potential Cause: The high cost of dry-dock construction, lack of strong attitude and determination among the facilities for investing in this infrastructure, which will have a long-term return, due to the facilities lack the ownership of the area.

Upgrade Plan: Transition to dry-dock use is considered difficult if TOKİ does not provide guarantees to business owners regarding prospective land use, the 20-year lease term is not extended to a longer term such as 49 years, or if the parcels are not sold to SR facilities. It is expected that as a result of acting together with the enterprises and conducting lobbying activities, explaining the need for dry-dock utilization together with the environmental benefits it will bring, and carrying out actions in this direction with TOKİ and the authorities will be beneficial in this respect.

Budget: May vary depending on the size of the project.

Time: 24-36 months if decision is made to build a dry dock.

7.1.6. Reusable Material Stock Area

Definition: Lack of second-hand material stock area.

Potential Cause: Insufficient facility stock areas.

Upgrade Plan: As mentioned in the Existing Facility Area Expansion Problem, effective use can be achieved by obtaining the plots in the background that may be put up for sale in the future by TOKİ or by analysing the existing stock area efficiency.

Budget: Depends on the location, size and current prices of the lands to be purchased. Stock area efficiency analysis will cost approximately 10-15 thousand USD per facility.

Time: The date/duration of land acquisition is uncertain. Stock area efficiency analysis will take 3-6 months.

7.1.7. External Transport Issues

Definition: There are problems in the transportation of scrap steel and waste.

Potential Cause: Delays/inadequacies caused by factors outside the facilities.

Upgrade Plan: Trucks arriving late to the facilities from time to time or lack of planning in the field can be a problem. Excess material in the field can cause delays in operations and congestion in manoeuvring areas. In addition, having to send the cargo at the same cost even when the amount of scrap to be sent out of the facilities is low from time to time creates high transportation costs. One way out of such situations for the facilities might be to own their transport trucks or develop communal systems. When not needed at a certain facility, it may be possible to rent transportation vehicles to other facilities.

Budget: Depends on the number and carrying capacity of transport trucks.

Time: Continuous application.

7.2. Machinery, Equipment and Technology

The problem areas identified for the facilities under the machinery, equipment and technology title are as listed below.

- Lack of Waste Incineration Unit and Waste Power Generation Facility
- Old Technology Machinery and Equipment
- Oxy-Propane Gas Cutting
- Lack of Machinery/Equipment Spares

Upgrade plans were evaluated one by one on the basis of these problem areas.

7.2.1. Lack of Waste Incineration Unit and Waste Power Generation Facility

Definition: Lack of waste incineration unit and power generation facility.

Potential Cause: Due to various reasons, especially the property problem, the facility owners avoiding investments in this regard and the wastes obtained during the SR operations being sold to the waste incinerators operating in and around Izmir.

Upgrade Plan: SR facilities serving in Aliağa District make contracts with waste management companies for the recycling/disposal of wastes resulting from the dismantling of scrap ships. This waste management strategy incurs costs at SR facilities. In order to get rid of such expenses and create added value, strategies of converting wastes to energy or different useful products should be considered.

Combustible wastes (hazardous wastes, waste oil, treatment sludge, etc.) originating from ships can be incinerated and energy can be generated in the waste incineration unit. This way, the energy needs of SR facilities can be met. On the basis of facilities, the merging of several facilities or the action by all 22 facilities together in this endeavour will both enable meeting the energy needs of the sector and increasing of in revenues in the long run. It is necessary to make the technical and economic feasibility of the process with initial studies and to analyse the benefits of selling the energy and using it in the facility. It is considered that there may be an opportunity to benefit from government supports or loans for the realization of this action. In the waste disposal process, high pressure water vapour can also be produced, which offers industrial symbiosis opportunities and can turn into profit when used in different industries and fields.

Budget: May vary according to the waste incineration capacity/the amount of energy to be produced.

Time: May vary according to facility size.

7.2.2. Old Technology Machinery and Equipment

Definition: The use of old technology machinery and equipment reducing operational efficiency and increasing risks.

Potential Cause: Equipment renewal becoming more difficult due to insufficient financing opportunities and government incentives, and uncertainties regarding the lease contract.

Upgrade Plan: Renewing and/or replacing the mechanical equipment used in SR facilities with new technology equipment will ensure that the works are performed is faster, and in a more efficient and safe manner. Providing low-interest and long-term loans for the use of modern technology in SR facilities and establishing various economic support mechanisms will contribute to the development of the sector.

Budget: May vary depending on the type, quantity and technology level of the machine/equipment.

Time: May vary depending on the type, quantity and technology level of the machine/equipment to be replaced.

7.2.3. Oxy-Propane Gas Cutting

Definition: Environmental pollution and fire risk due to the oxy-propane gas cutting used.

Potential Cause: Oxy-propane gaseous cutting releasing gas to the environment and possibly leading to fires due to contact with flammable materials spilled during shipbreaking.

Upgrade Plan: Facilities should consider the use of cold cutting methods, such as water-jet cutting, to avoid harmful gas emissions during the cutting process. Furthermore, environmental pollution and fire risks will be reduced with high capacity hydraulic shears suitable for operation requirements.

Budget: May vary according to product capacity requirement and quantity.

Time: 3-6 months

7.2.4. Lack of Spare Machinery/ Equipment

Definition: Delays in the process due to lack of machinery/equipment spares.

Potential Cause: Company policies, reactive thinking and unwanted additional costs.

Upgrade Plan: Spares should be stored to protect against the risks of deterioration since the machinery and equipment utilized in the facilities, particularly at critical points, are crucial for operation and process efficiency.

Budget: Varies according to the need for additional machinery and equipment.

Time: Continuous application.

7.3. Knowledge and Experience

Problem areas identified in facilities under the title of Knowledge and Experience are listed below.

- Lack of Design for Recycling
- Lack of SR Manual
- Lack of R&D Centres
- Granting Waste Collection Authorization to Companies
- Second-Hand Parts Certification Issue
- Operation and Labour Losses
- Reactive Approach Risks

Upgrade plans were evaluated one by one on the basis of these problem areas.

7.3.1. Lack of Design for Recycling

Definition: The increase in challenges, time losses and environmental risks in the recycling process as a result of the lack of an appropriate design approach that also considers recycling in shipbuilding.

Potential Cause: Lack of a Design for Recycling approach in shipbuilding.

Upgrade Plan: The design and production of environmentally friendly and recyclable products are called “design for recycling”. There are successful examples where the design for recycling has been applied to various products. However, few researchers have explored the possibility of applying this design approach to ships.

Establishing a bridge between the stages of shipbuilding and shipbreaking and carrying out studies in this direction will provide operational convenience and environmentally friendly recycling opportunities for the ships that will be built now and recycled 20-30 years from now. Considering the future recycling of ships, special modular, easily disassembled equipment and more environmentally friendly designs will be very valuable in terms of environment, human health and safety. In this context, it is necessary for shipyards, SR facilities and related departments of universities to work together and develop cooperation on reverse engineering, which includes carrying the difficulties experienced in dismantling to the design stage.

Budget: Will be finalized after the scope and sides of the design for recycling are determined.

Time: 24-36 months

7.3.2. Lack of SR Manual

Definition: Losses due to lack of standardization in the recycling process of different types of ships or floating structures.

Potential Cause: The perspective, awareness and institutional capacity of the sector on the subject need to be strengthened.

Upgrade Plan: There is a high degree of uncertainty in shipbreaking due to the varying process depending on the material compositions of the specific ship. This makes it difficult to plan and control the ship's recycling process. Through provision of necessary knowledge and analyses on the field experiences of SR facilities, the infrastructure of the sector will become stronger.

The preparation of a SR manual covering, in addition to general SR process, the following elements for each ship type or floating structure will contribute to the realization of more efficient ship dismantling/recycling operations in the sector.

- ·Process management
- ·Process mapping tool
- ·SR plans
- ·Material flow analysis
- ·System definitions
- ·Waste definitions
- ·OHS requirements and measures

Budget: 25-50 thousand USD (Depends on the manuals' coverage of separate ship types in addition to the topics of general SR operations).

Time: 12-24 months

7.3.3. Lack of R&D Centres

Definition: Lack of R&D centres or R&D units within the businesses.

Potential Cause: Seeing no need for R&D studies and traditional approach being dominant.

Upgrade Plan: Due to its structure, a ship consists of a combination of many complex systems and subsystems. These systems/subsystems require many new engineering designs for different ships or floating structures. Establishing a facility-based R&D centre for the SR processes or establishing a main R&D centre with a joint venture of the facilities is necessary both to ensure process efficiency and to obtain more environmentally friendly and more value-added solutions. T.R. Ministry of Industry and Technology has significant supports and incentives offered for R&D centres.

Budget: Depends on the capacity of the R&D centre.

Time: Will vary according to the amount of equipment and personnel to be employed by the R&D centre.

7.3.4. Granting Waste Collection Authorization to Companies

Definition: Increased workload of facilities due to the Authorization for Waste Collection, formerly performed by GEMİSANDER, being transferred to the facilities.

Potential Cause: Transfer of the authorization for detection, collection, temporary storage, sending to disposal/recycling facilities and reporting of hazardous wastes originating from scrap ships, granted with the permission numbered B.18.0. ÇYG.0.01.02-147/6033, formerly under the responsibility of GEMİSANDER, to SR facilities in 2021.

Upgrade Plan: GEMİSANDER, the umbrella organization of the sector, has gained serious experience with the waste collection operations it has been carrying out since 2010. With these processes, which the association has carried out while generating income, waste management is also controlled from a single source. In the new process, each facility will be responsible for its own waste. While this system increases the profits of the facility owners, it also imposes a serious responsibility. In order for the process to be carried out smoothly, it is important for the facilities to make the necessary arrangements

with experienced personnel and to continue their cooperation with GEMİSANDER.

Budget: The income of the facilities during this transition period will more than meet the investments to be made.

Time: Will continue until the infrastructure and activities in accordance with national and international rules and regulations are completed.

7.3.5. Second-Hand Parts Certification Issue

Definition: Certification of unused or in good condition materials found on the dismantled ship.

Potential Cause: Lack of regulation or ship owner's terms of sale.

Upgrade Plan: It will be possible for the facilities to quickly certify and sell the product with the legal regulations to be made, if the ship owner does not present any special terms.

Budget: No budget need.

Time: No time range specified.

7.3.6. Operation and Labour Losses

Definition: Operation and Labour Losses.

Potential Cause: Lack of personnel/material/machinery/energy etc. efficiency measurements and evaluations in the shipbreaking process.

Upgrade Plan: Shipbreaking process modelling/optimization should be carried out supported by simulation programs such as Arena, compatible with field studies that truly model the SR process.

Budget: The cost of purchasing external support for the acquisition of an optimization culture, and the measurement and simulation activities is expected to be around 40-50 thousand USD on facility basis.

Time: Modelling/optimization process on site basis is 12-18 months. Continuous application by facility workers afterwards.

7.3.7. Reactive Approach Risks

Definition: The need for a strong approach that takes action before the problem in order to reduce occasional accidents at SR facilities

Potential Cause: The reactive, traditional perspective in line with a passive approach that takes action after occurrence being dominant among the employees and the management.

Upgrade Plan: Should include continuous training practices that will be supported by teamwork and simulators, which will enable the facility employees to participate effectively in shipbreaking processes with a proactive approach, thanks to providing them with a productive perspective that increases their awareness of both themselves and their environment and enables them to see the whole and their role in the whole.

Budget: Low budget requirement.

Time: Continuous application.

7.3.8. Lack of Learning Culture

Definition: A learning culture needs to be developed towards reducing occasional accidents at SR facilities.

Potential Cause: Learning and continuous development culture not being dominant enough among the employees and the management.

Upgrade Plan: A learning culture training consisting of actions to be taken on values, attitudes and activities that will improve the knowledge and skills of the employees in the facilities and ensure continuity in safety issues should be conducted. Developing a learning culture that will increase safety with respect to the factors arising from human factor, technical elements, organizational structure and organizational environment, where the data will be used effectively, will increase the knowledge and skills of the employees and will also encourage them. Thus, risks will be reduced by increasing efficiency of on-site production, cutting and recycling processes.

Budget: Low budget requirement.

Time: Continuous application.

7.4. Human Resources

The problem areas identified under the title of Human Resources are as listed below.

- Worker Continuity and Circulation
- Lack of Qualified Personnel
- OHS Training Deficiencies
- Lack of Redundant Personnel
- Lack of Shift System

Upgrade plans were evaluated one by one on the basis of these problem areas.

7.4.1. Worker Continuity and Circulation

Definition: Issues faced in the employment of workers.

Potential Cause: Inability to ensure worker continuity in the facilities due to the heavy and risky industry. Frequent personnel circulation between facilities.

Upgrade Plan: It is necessary to follow policies in the human resources department that will ensure employee continuity, support a culture of belonging, and strategies that include social development and group activities.

Budget: The budget to be allocated will be insignificant, as SR operations efficiency will increase. Budget may vary according to company policies.

Time: Continuous application.

7.4.2. Lack of Qualified Personnel

Definition: Difficulties in finding qualified personnel.

Potential Cause: Trained personnel transferring to other sectors due to shipbreaking being a heavy and risky industry.

Upgrade Plan: The two critical questions asked in the Resilience Engineering fieldwork were “Is there a backup for personnel working in critical sections of the facility” and “Do the personnel think management values them”, and the answers to these questions remained in the low-to-moderate range. For this reason, it will be important for the facilities to understand the reasons underlying the loss of qualified personnel and to follow policies accordingly. In addition, the need for intermediate staff will be met in the long term, by acting proactively and making agreements with vocational high schools, technical high schools and universities in the region. In this context, joint strategies can be developed with public institutions and organizations and opportunities to find loans to train intermediate staff can be explored. It would be beneficial to include GEMİSANDER, the umbrella organization, in the implementation.

Budget: The budget to be allocated will be insignificant, as SR operations efficiency will increase. Budget may vary according to company policies.

Time: Continuous application.

7.4.3. OHS Training Deficiencies

Definition: Occasional accidents at SR facilities.

Potential Cause: Monotony, inefficiency in OHS trainings.

Upgrade Plan: It was learned in the field studies that the OHS trainings given and constantly repeated by the facility personnel lead to monotony over time. OHS trainings using dynamic simulators, which will make lifelong learning a lifestyle with the participation of academic staff from universities, will be beneficial for safer shipbreaking operations.

Budget: It has a low budget, but applications such as simulation may increase the budget.

Time: Continuous application

7.5. Financial Resources

7.4.4. Lack of Redundant Personnel

Definition: Delays in the operations due to lack of personnel redundancy.

Potential Cause: Company policies, reactive thinking and unwanted additional costs.

Upgrade Plan: Personnel in critical places in the facilities should be identified, backup personnel should be employed, and company strategies should be defined in order for the backup personnel to have the necessary competence.

Budget: Varies according to the need for critical personnel.

Time: Continuous application

7.4.5. Lack of Shift System

Definition: Long working hours for the personnel employed in the facilities.

Potential Cause: Company policies, reactive thinking and unwanted additional costs.

Upgrade Plan: It was ascertained that the personnel employed for field work have an average of 8 hours of work per day at the SR facilities. A shift system will make a positive contribution to efficiency, as the sector is a heavy industry and inherently contains a lot of risks. For instance, it may occasionally not be possible for a welder to cut, eight hours a day, with the same efficiency in very hot/very cold weathers. With the SR process simulations and the daily cutting rate comparisons to be made among the personnel, a decrease in performance can be easily observed. A proper operation and shift system will also reduce the occurrence of accidents at the facilities.

Budget: May vary according to the number of shifts and personnel required.

Time: Continuous application

The problem area identified under the title of Financial Resources in the facilities has emerged as Financing and Credit Problems.

7.5.1. Financing and Credit Problems

Definition: SR facilities financing and credit issues.

Potential Cause: Companies' lack of facility land ownership rights, political uncertainties regarding the renewal of the lease agreement of the facility land leased from TOKİ, which will expire in 2026, occasional damage to credibility in the eyes of the public, and increase in Türkiye's credit risk.

Upgrade Plan: Low-interest and long-term loans are needed to ensure the use of modern equipment, machinery and technology at SR facilities, to increase operational efficiency, to purchase new scrap ships or to create different growth strategies. The supports that can contribute to the development of the SR sector are as listed below.

- Supports from the state
- Incentives such as tax reduction/exemption etc.
- Public and private bank financing supports
- Various economic support mechanisms to be provided by international institutions and organizations such as the World Bank.

In order to provide these supports, facilities need to develop strategies that will strengthen their reliability/financing, and to soundly model their projections for financing.

Budget: Will vary according to the size of the loan and financing required and the actions planned by the facilities.

Time: Will vary according to the scope of the project.

7.6. Relations with Suppliers, Industry Actors and Public

The problem areas identified under the title of relations of the facilities with suppliers, industry actors and public are as listed below.

- Need for informing the public on the sector
- Lack of cooperation inside and outside the sector
- Occasional failure to quickly react to transition to international regulations

Upgrade plans were evaluated one by one on the basis of these problem areas.

7.6.1. Need for Informing the Public on the Sector

Definition: The importance of the location of this sector, which is crucial for the renewal of the naval fleet in the world and the realization of maritime transport, not being sufficiently known among the public.

Potential Cause: The critical role of this sector, which is now accepted as a recycling activity in the world, in terms of different dimensions such as the realization of intercontinental trade, the reduction of maritime accidents and risks, the supply of raw materials to the iron and steel industry of our country and its substantial substitution of import needs, is not sufficiently known by the public.

Upgrade Plan: It is important that the developments in the compliance of the facilities serving in Aliağa with national and international rules and regulations, the provision of raw materials, added value and employment to the country's economy through the dismantling activities, the critical position of the sector are all recognised in the eyes of the public and the relevant information flow is ensured. It is important to establish healthy communication with relevant public institutions and NGOs, to develop policies on transparency, to increase positive approaches to occasional information requests and facility visits from the press, universities and NGOs. In this regard, GEMİSANDER, the umbrella organization of the sector, has duties in terms of developing the right communication policy.

Budget: May be realised with a low budget.

Time: Continuous application

7.6.2. Lack of Cooperation Inside and Outside the Sector

Definition: Lack of cooperation that should contribute to the development of the sector.

Potential Cause: The facilities focusing on approaches that will save the day rather than long-term solutions that will improve the sector through cooperation.

Upgrade Plan: Cooperations inside and outside the sector for developing the sector have the potential to increase the business volume. For instance, in the recycling of large-tonnage ships, several facilities can act together, optimizing the process and the dismantling area. Facilities can establish waste incineration units and power generation facilities and produce their own oxygen in cooperation. In this process, the experiences of different industries can be utilized through cooperation. The area required for 'dry-dock dismantling', which is a more controlled method in SR, can be Assigned for common use and large block cutting operations can be performed in this safe space. Dry-dock construction is subject to permission and it is very difficult for non-proprietary facilities to act without government support in this regard. In addition, by cooperating with universities, SR process optimization, efficiency, OHS trainings can be obtained through experts and engineering approach applications can be brought to the sector.

Budget: Initially, the contacts and meetings required for cooperation within and outside the sector will have a very insignificant budget. Projects to be realized through bilateral agreements will differ according to the content and outputs of the project.

Time: Continuous application

7.6.3. Occasional Failure to Quickly React to Transition to International Regulations

Definition: Delays in complying with global regulations.

Potential Cause: Issues related to management culture.

Upgrade Plan: Facilities may occasionally have difficulties in adapting to global developments and regulations. In this regard, the company's reactive culture and financing difficulties come to the fore as the most critical factors. For instance, not all facilities have adopted the policy of meeting the compliance criteria and making a quick application for inclusion in the EU List. First, some facilities took the initiative, got listed, other facilities followed the process and then implemented the necessary regulations to start the process. This is also due to the fact that more environmentally friendly approaches are more costly. Developing proactive management approach strategies instead of traditional policies will make positive contributions to the sector in this respect.

Budget: Low budget.

Time: Continuous application

7.7. Conclusion and Evaluation

Elimination of existing problems and implementation of upgrade plans in İzmir Aliağa SR facilities will alter to the state of the sector and increase productivity. 22 existing SR facilities should make the necessary arrangements by adapting the deficiencies and upgrade plans introduced in this section for their own facility and should prepare action plans to realise their upgrade plans. Even if companies improve/optimize shipbreaking processes in the field using only their existing resources, make value-added operation definitions and increase the quality of work performed by their personnel, these will lead to significant cost reductions, less energy consumption and emissions, and increase efficiency. Although there are cross-cutting issues in the upgrade plans, needs and solution proposals in terms of information, cooperation, communication and support have been put forward in general. These solution proposals can be developed through conducting more detailed studies and can be the subject of specific projects.

CHAPTER 8.

Final Conclusions

The average life span of a ship has been recognised as 25 years by the International Maritime Organization (IMO). After this period, the maintenance and operating costs of the ship exceed its income and constitute serious risks to the environment and people. When the costs of a ship approaching the end of its life span compared to a new ship are examined, it may be mentioned that there is an additional cost increase of 28% in personnel expenses, 25% in stocks and consumables, 139.5% in maintenance and preservation expenses, 115.8% in insurance expenses, and 45% in daily operating expenses. There are many factors when a ship owner sends their ship for recycling, perhaps the most important of which are freight rates. There is an inverse relationship between freight prices and ships sent for recycling.

The most economical and environmentally friendly solution in the future of ships that have completed their average life is to be recycled. With SR, approximately 95% of a ship is dismantled for reuse and an environmentally friendly process is carried out in which almost no waste is left behind. Materials such as steel, iron, aluminum and plastic obtained from scrap ships are recycled and used in the production of new products in the industry.

SR operations are carried out in many different geographical regions around the world. While it was mostly carried out in the USA and Europe until the 1970s, the industry shifted to developing countries such as Bangladesh, India and Pakistan due to strict environmental protection laws, occupational health and safety rules. According to 2020 data, Bangladesh, India, Pakistan, Türkiye and China dismantle 98% (83% by Bangladesh, India and Pakistan) of the total empty ship weight (Light Displacement Tonnage - LDT). In Bangladesh, India and Pakistan, which use the "dismantling by beaching" technique, the method most hazardous for the environment and people; the environmental pollution caused by the facilities, the hazardous waste collection and management approach and the SR operation risks cause serious concerns in worldwide public opinion. In addition, the desire of ship owners to prioritize their financial gains leads to the sale of scrap ships to underdeveloped countries.

There are international rules and regulations such as Basel Convention, Hong Kong Convention, International Labour Organization Guideline and European Union Ship Recycling Regulation for the recycling of scrap ships with the most environmentally friendly and safest dismantling methods. The EU SR regulation imposes certain requirements on safety and environmental needs for shipbreaking facilities. This regulation, which came into force as of 31 December 2018, obliges all large ships sailing under the EU member state flag to use an approved SR facility included in the European Commission Ship Recycling List (European Commission (EC), 2016). Considering that 40% of the world's commercial fleet is in Europe, this is an important regulation and has a legally binding aspect for ship owners. However, EU-flagged scrap ships can be sold to cash buyers in the industry by ship owners who want more financial gain, and these cash buyers can switch the EU-flagged ship to the flags of countries where maritime law is abused (Comoro, Palau, St. Kitts, Nevis etc.) and then scrap the ships. They can thus sell to the highest bidders such as Bangladesh, India and Pakistan. Such a process contributes to the continuation of non-environmental SR operations. The fact that ship owners recycle their ships through cash buyers makes it difficult to hold them accountable for illegal practices. The fact that only 5% of the ships that have expired in 2020 were EU flagged confirms that this such practice is prevalent. (NGO, 2021c).

In Türkiye, SR operations are carried out only in İzmir Aliağa. 22 facilities in the Aliağa SR region carry out shipbreaking by using the landing technique, a technique considered to be environmentally friendly. The facilities have a total area of 403,710 m2 and a steel processing capacity of 1,450,000 tons. Türkiye is the country that has managed to enter the EU Commission Ship Recycling list with the highest number of SR facilities (8 facilities). Considering the EU's annual scrap potential of 1.5-2 million LDT, the aforementioned regulation gives Türkiye an advantage. According to the EU's list dated June 20, 2021, it is seen that 9 more facilities from Türkiye have made official applications, and it is expected that the remaining 5 facilities will complete the necessary application procedures to enter the EU list in the coming period. This is considered as an important development in terms of improving both the competitiveness and environmental and safety standards of the facilities in Aliağa.

When the shipbreaking activities of the past 12 years in the region are examined, it is observed that the activities carried out in 2020 happened to have the least number of ships and the highest GT of ships. This points out to the impacts of Covid-19, which has

influenced the whole world, and that the epidemic has positively affected the SR sector. Especially the recycling of large tonnage cruise ships has revitalized the sector and enabled the sector to gain cruise ship dismantling experience. In this respect, the international public awareness of the Aliağa SR sector has also increased.

The number of workers working in the sector reached 1700 in 2012, when the SR operations were observed to be at their peak. When the number of workers working in SR is evaluated together with the sub-industry branches, it reaches 10,000 people. This means an important employment for İzmir's economy. According to the data obtained for 2020, Işıksan, Aliağa Gemi, Öğe Gemi, SÖK Denizcilik and Leyal Gemi companies performed the most SR. These companies are five of the 8 companies included in the EU list.

The waste management-tracking system created by the Ministry of Environment, Urbanization and Climate Change in 2007 is used in the waste management of the shipbreaking facilities of Aliağa District. The authorization for scrap ship waste detection, temporary storage, disposal and reporting to the relevant authorities, carried out by GEMİSANDER Waste Management Centre Unit until 2021, were transferred to the SR facilities themselves as per the circular of the Ministry of Environment, Urbanization and Climate Change. This transfer, which will cause a serious decrease in GEMİSANDER's revenues, will provide additional income to the facilities while also imposing certain responsibilities in waste management. 81% of 15,829 tons of waste in 2017 and 90% of 17,469 tons of waste in 2019 were recycled. This points out that there is a serious experience, knowledge and awareness in waste recycling.

Within the scope of the İzmir Aliağa SR Sector Analysis study, literature reviews, facility visits, and interviews with the personnel actively working in the facilities and outside experts were conducted. Survey studies were conducted to reveal the sector's knowledge of the current situation, and the needs and values. The world SR industry was studied and the shipbreaking activities performed in Bangladesh, India and Pakistan, the leaders in shipbreaking, were evaluated. International IMO, ILO, Basel and Hong Kong Conventions and European Union Ship Recycling Regulations, which have critical importance in shipbreaking, were examined and SR methods used in the world and in Türkiye were discussed. The current situation, infrastructure and basic operation steps for İzmir Aliağa GGD sector were examined in detail and SWOT, Pareto, Five Forces, Kaizen, PESTLE, Six Sigma Analysis and Resilience Engineering and Principles were utilised in the sector analysis. Based on the information obtained from these methods, upgrade plans have been prepared for the dimensions where the facilities are found to have weaknesses in terms of efficiency, sustainability, resilience and flexibility.

Upgrade plans for Aliağa SR facilities have been carried out for the current problems addressed under the following six main topics:

- Physical Infrastructure
- Machinery, Equipment and Technology
- Knowledge and Experience
- Human Resources
- Financial Resources
- Relations with Suppliers, Industry Actors and Public

Recommendations were developed and an upgrade plan was prepared for each existing issue. Within the scope of the upgrade plans, the details of which may be examined in Section 7, certain actions that can be considered for increasing the efficiency, sustainability and resilience of the companies are as follows:

1. Purchasing appropriate lands close to the facilities and moving certain functionalities such as product storage, stock management or personnel offices that do not take an active role in the operations to these areas in order to expand the SR operational area of the existing facilities,
2. Effectively conducting the necessary contacts and lobbying activities to ensure land ownership, which is critical for long-term policies and investments,
3. Carrying out machinery and personnel simulations and optimization studies in the scrap ship dismantling process for more efficient use of the existing facility SR sites,
4. Developing solutions such as large infrastructure elements such as dry-dock and joint transportation systems in order to increase efficiency and provide cost advantage,
5. Developing a waste incineration unit to provide energy production capacity,
6. Renewal and/or replacement of mechanical equipment with new technology equipment to make the SR process faster, more efficient and reliable,
7. Making actions to switch to cutting methods with water jet and high capacity hydraulic shears instead of cutting with non-environmental oxy-propane

gas,

8. Developing backups for human resources, machinery and equipment at critical points in order to increase efficiency in operations and processes,
9. Carrying out reverse engineering studies to improve the design concept for recycling,
10. Preparation of a SR manual to increase standardization and institutionalization in processes,
11. Establishing R&D centre and increasing the R&D capacity in the sector,
12. Receiving support from expert institutions and personnel for the arrangements and activities to be carried out within the facilities, since the waste collection authorization is transferred to the shipbreaking facilities,
13. Quickly certifying the products obtained by the facilities by way of ensuring that legal regulations are realized in respect to the second-hand parts,
14. Making efficiency measurements and evaluations of personnel/materials/machines/energy etc. in the shipbreaking process by using simulation programs and full field studies, and implementing an effective inventory planning and management for the processes,
15. Conducting proactive training practices in order to strengthen the rapid identification of needs and problems in advance,
16. Developing a learning culture within the facilities with learning culture and lifelong learning trainings,
17. Preparing strategies that will strengthen worker continuity and reduce circulation, and working with vocational high schools, technical high schools and universities in the region to meet the need for intermediate staff within the scope of the human resources policy,
18. Increasing personnel productivity and reducing risks by switching to a shift system,
19. Developing institutionalisation strategies that will increase the loan and financing opportunities needed by the sector, and increase transparency and relations with the public,
20. Developing a cooperation approach in the sector, realising cooperation inside and outside the sector to make progress on important issues.

It is an important shortcoming that the 22 shipbreaking companies in İzmir Aliağa District do not have ownership rights on the lands in which they operate. This circumstance also prevents investments such as hiring more employees or acquiring more machinery/equipment/technology, which are directly related to increased productivity/efficiency. Monitoring and analysis of this property-related process, and identification and implementation of future steps are priority issues for facilities.

Although stricter working conditions are one way to increase productivity, it has been evaluated that this is not a sustainable and desirable situation due to the nature of the sector. The sector is currently experiencing personnel circulation and a lack of skilled labour. One of the most rational approaches that can be adopted in the short term is to follow policies that will increase the quality of work with the existing resources and to develop value-added SR operations. It was observed that a good process/personnel optimization can be performed for each facility in the SR sector. With the help of a simulation program, it may be possible to examine the factors that hinder or slow down the process in the field or need improvements, to take measures against them, and increase the quality of life of the personnel working in the facilities.

Considering the added value that SR facilities provide to İzmir Province and the surrounding regions, the importance of the sector for this region should not be overlooked. With infrastructure investments and rational policies, the annual steel processing capacity of the sector can be increased to 2 million LDT, which is an added value of approximately 1.5 billion USD annually. In addition, high quality scrap steel is sold to the industry by way of the SR sector, and these products become a high quality raw material source for the iron and steel industry.

Another important point is that instead of producing one ton of steel from hematite ore, producing one ton of steel from scrap, which is the output of the sector, provides 1.680.555.56 MJ energy gains and 1.920.000.000 kg less CO2 emission to the environment. It is considered important that the facilities in the sector, which make more efforts towards becoming a green (environmental) industry, strengthen their relations with public institutions, universities, non-governmental organizations, media organizations and international stakeholders. Moving towards more proactive approaches from traditional policies and thus increasing the capacity to keep up with global developments, changing situations and technologies will contribute to making this sector -concentrated only in İzmir in our country- more resilient, efficient and sustainable.

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İZMİR DEVELOPMENT AGENCY

Megapol Çarşı Kule, Halkapınar Mahallesi,
1203/11. Sk. No: 5-7, Kat: 19, 35170 Konak/İzmir

T. +90 232 489 81 81 **F.** +90 232 489 85 05

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