Dissertation for Master's Degree

# A STUDY ON THE COMPETITIVENESS OF SHIP REPAIR INDUSTRY IN BUSAN AREA USING AHP

Supervising Professor: Dong-Keun Ryoo

May 2011

Graduate School of Korea Maritime University

Department of Shipping Management

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# Abstract

This research has been designed for upgrading the competitiveness of ship repair industry in Busan area. In a country that is regarded as an established global leader in shipbuilding like Korea, a more or less performing status could be assumed for the ship repair industry. However, the findings of this research using AHP methodology to analyze the results of a questionnaire handed over to stakeholders of ship repair industry in Busan area on the basis of a SWOT matrix, underlined on one hand, a very weak status for ship repair industry in Korea compared to its neighboring competitors especially in china and Singapore mainly due to limited capacity repair facilities. On the other hand, this research confirmed the potential of Korea and Busan area to develop a high specialized ship repair industry such as for LNG & LPG vessels taking advantage of its leadership in building such high technology vessels to secure a niche in the ship repair industry where competitiveness is measured in terms of know-how and not in cost.

# Chapter 1 Introduction

## 1-1 Research Background and Objectives

### 1.1.1 Background

Korea is worldwide known for its shipbuilding industry as an established global center contributing in the world's shipping supply capacity, through its shipbuilding yards. Same performance can be expected from such other related industries such as ship repairs. However, Korea's ship repair industry is miles away behind its direct competitors. We are talking about less than 10,000 dwt as Dry-docking capacity in Korea while in neighboring countries dry-docks for vessels bigger as VLCCs are available.

Global Ships repair industry, however different from the shipbuilding one, is suffering from the same depression in revenues combined unfortunately to a considerable overcapacity. Though a pessimistic forecast for the ships repair industry which may for a while hinders any investment, it is believed to give much more incentives to develop special niches where the competitiveness is measured in terms of know-how and not in cost. Korea has the necessary experience and skills to secure profitable niches in the ships repair industry.

### 1.1.2 Objectives

Busan region has been claimed, and strategic need has been underlined, to leap into a hub for shipping and logistics services in the North East Asia region. Broadly speaking, a hub is the fastest way and the most efficient node linking all stakeholders in the shipping business without big deviations. It's all, what ship repair industry is about. When a ship owner is scheduling his vessel for repairs, beside other factors, his decision on where to repair will be taken in a way to incur the least deviation possible from last port called towards repair yard and to place the vessel in the best position for next voyage after repairs done.

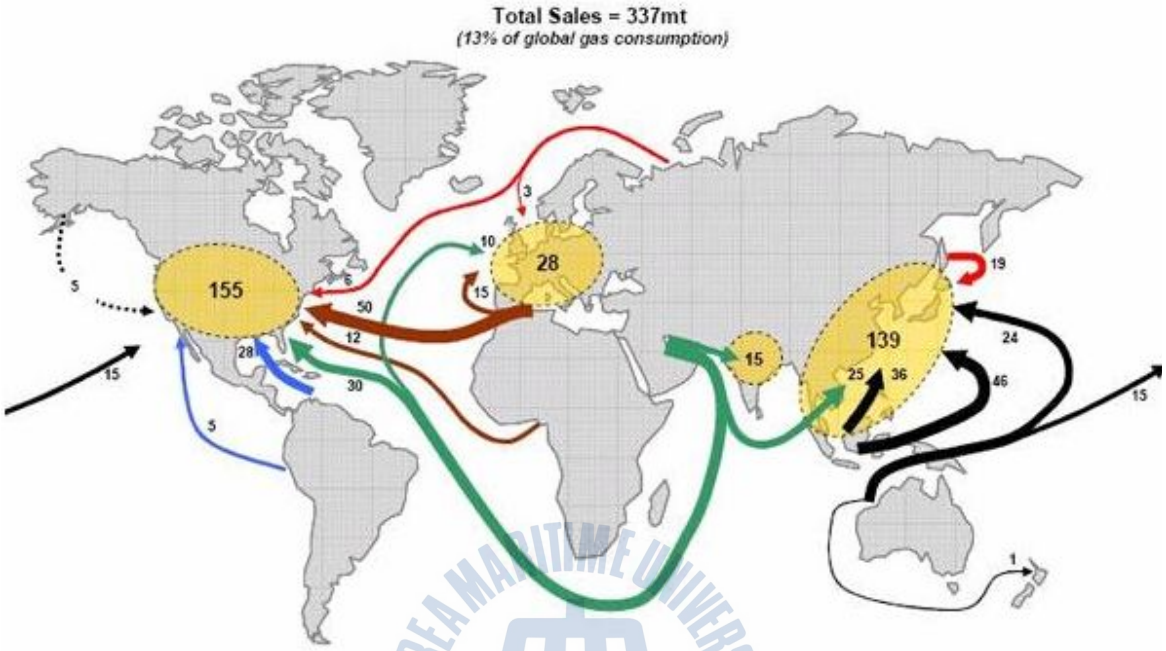
This status of a hub has then a big deal to do with what kind of services the port area is offering. The repair facilities are an important element and can serve to add to the attractiveness of a port area to shippers and ship-owners. However, regardless of demand and pricing dynamics in ship repair industry, Busan area, and generally speaking Korea, doesn't have actually the necessary facilities to satisfy an increasing demand in ship repair.

Knowing that Korea is obviously a global leader in newbuilding, especially for high added-value and technology vessels such as LNG carriers and other LPG carriers (see Table 3-3 below) as well as beside the fact of being a global importer and situated closely to other global importers (i.e. Japan) and global exporters in the Asian region such as Indonesia and Russia (Figure 1-1) and given the fact that repairs costs are almost same as in Singapore (see Table 2-12 below) , the current global renown repair centre for LNG and specialized vessels' repairs , and much more cheaper than in Japan the world's first LNG importer, this study is to demonstrate the potential of Busan region to leap for regional and a global ship repair centre and explore ways to develop this potential for high value added jobs and propose the adequate plan to heighten the competitiveness of Korea into a specialized ship repair industry.

## 1-2 Research Scope

This research is concerned with the analysis of competitiveness of ship repair industry facilities within the region of Busan in South Korea. However the survey study that will be conducted for the purpose of collecting empirical data will include respondents from other regions in Korea such as Seoul where the main concentration of headquarters of shipping companies in Korea and foreign companies established abroad as well which should be familiar and interested in the Busan ports area, as to be able to answer the questionnaire formulated on the basis of a SWOT analysis of the Busan area ship repair industry performed below in this study.

**Figure 1-1: World LNG Trade Estimates to 2015**




Source: Lngpedia.com (Accessed May 2011)

## 1-3 Research Methodology and Structure

This study is to use the Analytic Hierarchy Process methodology. First, a literature review will be conducted covering research and thesis papers already published in the field. All the material and necessary primary data about the ships repair industry in Korea will be gathered from Korean organizations and institutions related to the shipbuilding and ship repair industry. The data analysis will yield a SWOT analysis on the basis of which a survey questionnaire will be formulated and handed over to Korean ships repair industry's stakeholders in Busan region, on the competitiveness factors of ships repair industry of Busan area considering the global and regional markets.

The Questionnaire results will be analyzed using the AHP method because it helps ranking and priotizing the SWOT matrix factors and develop a recommendations plan, with regard to the significance of each element with respect to the goal, for raising the competitiveness of Busan ship repair industry.

In this regard the study will be structured into five (5) chapters,

The chapter 1 as Introduction introducing the research background, objectives, methodology and structure.

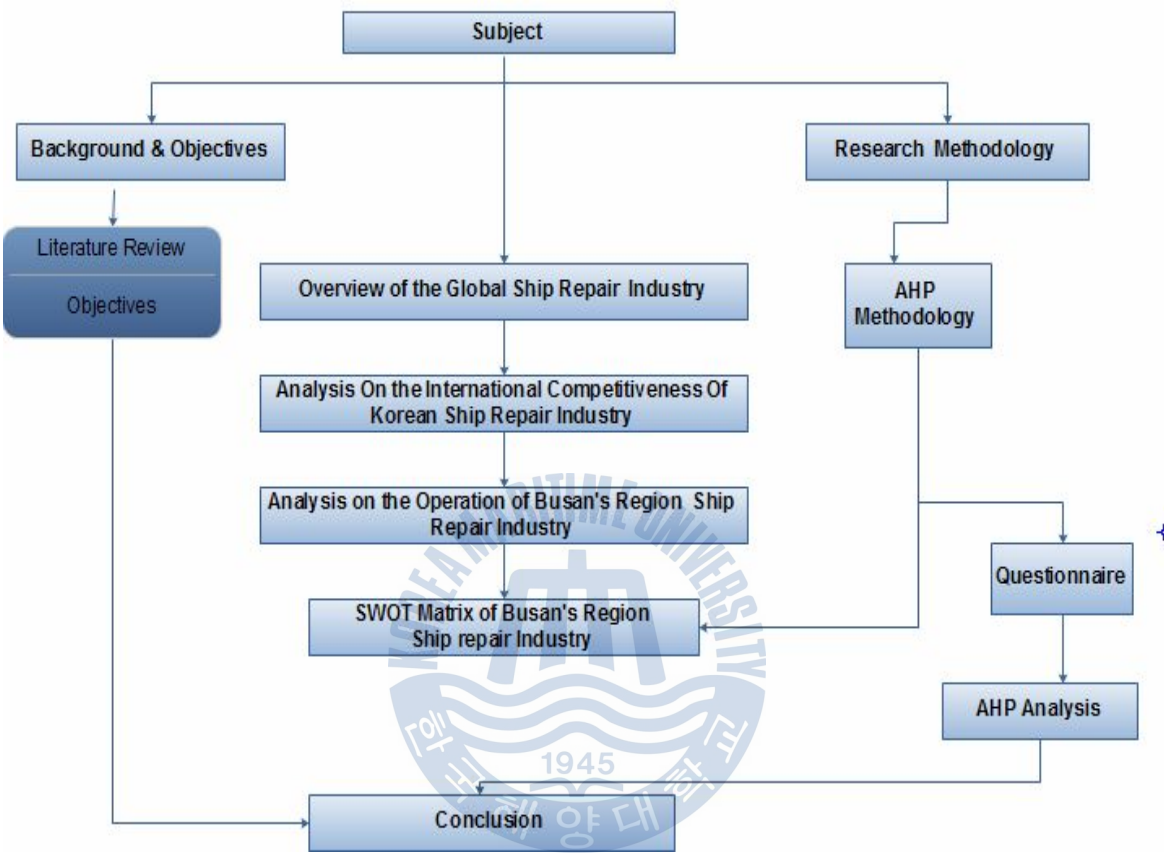
The chapter 2 will focus on the global ship repair industry, its development e and perspectives.

The chapter 3 after an analysis on the international competitiveness of ship repair industry in Korea will resume with analysis on the operational features of Busan area's ship repair industry to conclude with a SWOT analysis.

The chapter 4 will introduce the main research method of AHP and using the SWOT matrix developed in the previous chapter a questionnaire will be formulated and survey conducted. The results of the survey will be displayed and analyzed.

The chapter 5 as the last one will be a sum-up of above mentioned analysis as recommendations to develop and strengthen competitiveness in the ship repair industry in Busan region , also to explain limits and obstacles encountered for the present research and further research recommendations.

**Figure 1-2: Research Structure**




## 1-4 Literature Review

The literature review that this study was supposed to go through was greatly limited by the small amount of papers and thesis published in Korea about the subject of the ship repair industry. The few papers examined are then presented as follows in their chronological order of appearance :

Oh (1983), presented a scheme to upgrade the ship repair industry in Korea on the basis of analysis of the prevailing situation and problems pointed out.

Kim (1994) probably wrote the first study focusing on the area of Busan's ship repair industry, on its performing environment and plans for its development.

More studies along with the development of Busan port area, started to focus on Busan's ship repair industry as listed below.

- The Bank of Korea- Busan Branch (2003) probably published the first and the last study to go thoroughly in the prevailing situation of Busan area's ship repair industry, all the coming studies will be based on data from this study.
- Busan Development Institute (2005) published a study to promote firms able to enhance the competitiveness of Busan Port and marked the interest that local authorities are having for enhancing the shipping and port related businesses among them the ship repairs.

The above mentioned studies based on an analysis of the current status of the ship repair industry in Korea and Busan area proposed plans for the improvement of the competitiveness of the industry definitely performing in a more global market characterized by the rise of the Far east and Middle East players.

- Ha (2005) on the basis of a survey questionnaire to Busan port's customers, recommended that the upgrading of Busan port's competitiveness is primarily related, among other measures, to a development and building-up of ship repair complex to remedy to the scarce facilities and which he argued will be a driver to other businesses such as ship supplies, bunkering, and create more opportunities, given that other measures are taken in consideration like developing a research center, government support by tax reductions and enact a new special law for alien workers to provide a stable workforce for a labor intensive industry such as the ship repair.

- Oh, Sin, Lee (2007) The authors advised a plan for vitalization of Busan New port by activating ship repair industry for high value added jobs and specialized

vessels like LNG carriers, where technology is not yet mastered in emergent markets and gain a lead in this field by fostering the link between the port and ship repair industry as an incentive to choose the port of Busan by ship-owners for such repair jobs.

- Kim (2009) Based on a survey using the FHP analysis method of the results of a survey comparing Busan ship repair industry to regional centers in China and Singapore, with respect to selected competitiveness factors as; cost, repairs time, service quality, technical level and yard location, the author developed a scheme to improve the competitiveness of ship repair industry in Busan area focusing on three plans:

1. Upgrading the existing facilities for ship repair industry to accommodate bigger vessels, the existing facilities were limited to maximum 10,000 dwt vessels according to the same study.
2. To gain cost competitive advantage, industry players are invited to focus efforts on reducing labor cost, raw material cost, and spare parts, as these are considered by the author as core elements in the final repair cost quoted to ship owners.
3. on the service quality plan, more aggressive marketing and seeking to secure long term contracts with attractive discounts has been suggested strategies for more competitive industry, along with developing networking within the industry players and with customers to exchange data in order to reduce lead time and overheads.

- Song, Seo, Yum (2010) The authors of this study singled out the three factors of: 1) Cost of Repairs, 2) Repairs Technical Level and 3) Yard Location and analyzed their influence on the international competitiveness of ship repair industry compared to other global players in Europe, China, Japan, Vietnam and the Middle East. The study recommends a plan of three axes to improve the international competitiveness of Korea ship repair industry by underlying the urgent need of working on reducing the cost of repairs to gain a cost advantage which was pointed out as the main weakness of Korea ship repair industry; invest in new facilities and focus on specialized vessels' repair jobs.

The previous studies outcomes come to converge on certain findings about the scarce facilities for ship repair in Busan and the necessity to re-conquer this field by Korean players and in order to raise the competitiveness of Busan port by trying to build a cost advantage in ship repairs industry.

The study on hand, as opposed to previous studies, is to focus on ways and means to strengthen the competitive advantage of Korea's ship repair industry in Busan area especially, by securing niches in this business in specialized vessels' repairs jobs by stressing on the technologies related to the repair of specialized vessels yet to be fully mastered in the area and demonstrate the advantage that Korea and Busan region are enjoying in this field compared to direct competitors. By using AHP method to analyze the results of the survey object of this study axed on competitiveness factors of ship repair industry in Busan and analysis of the international competitiveness of ship repair industry in Korea compared to regional and global players.

# Chapter 2 Development of the Global Ship Repair Industry

## 2.1. Development of World Ship Repair Industry

This study is to focus on ships repair industry in high value added jobs such as specialized vessels' repairs in which ship repair yards in Korea may secure a high competitive advantage.

First of all, it is more academically correct and necessary to go through some special features of the ship repair industry here, while it tends to be often confused with the shipbuilding one, which made it difficult even for this study on matters related to data collection.

This doesn't ignore that there are much similarities and interaction between both industries of repair and new building but for the good sake of this study which is concerned with the competitiveness aspect, its more helpful to consider the special features of ship repair industry as opposed to shipbuilding in order to deeply understand, and assess challenges and opportunities to ship repair industry.

Ship repair industry is a highly competitive industry, with yards all over the world, a competitive situation complicated with the condition that shipyards have traditionally been and would be always situated in or not far from the biggest ports and the main trading routes leading to them. But new yards have entered the market and the international tendering process, with bargain prices being offered in the yards of the former Soviet Union and Eastern Europe, China and Vietnam in the Far East. Traditional big repair centers like Rotterdam, Hamburg, Singapore and Japan have already lost precious market shares, for these new comers especially for general repairs works.

In contrast to the shipbuilding industry the ship repair is a service industry and not an industrial production one. However, both are labor and capital intensive, but to a lesser extent in the ship repair. The labor intensity makes it not easily prone to automation despite

the technological advancements realized in the field; this is obviously giving a large cost advantage for developing countries, new comers, with available low cost labor supply when bidding for general repair work.

In addition, modern vessels are increasingly complex, with automated systems and electronics that require constant attention as well as regular maintenance and rectification and this has also increased the need for greater sophistication and skills on the part of the repair services providers.

Modern ship repair industry has then, developed highly technological feature and seen many yards investing in sophisticated equipment to ensure high safety and environmental standards when carrying out maintenance and repairs.

World fleet sees, since 2008, an exponential increase in tonnage due to the recent deliveries ordered against the high freight market up to 2008 (Fig 2.1).

**Figure 2-1: 5 Years of the Baltic Dry Index**


*Source: Bloomberg.com (Accessed May 2011)*

Modern fleets and younger vessels also means less maintenance, the gloomy freight market is pushing elder tonnage to breaking yards, and record number of vessels have been on lay-up (Fig 2-2 & Fig 2-3).

According to the latest figures form Clarkson Research, newbuilding orders were down almost 60% in January (2011) from a year ago[1]. On another hand, and in terms of ship's size, *AP Moller-Maersk Group* has recently inked contracts at South Korea's *Deawoo Shipbuilding &Marine Engineering* yards (DSME) to build 10 of the biggest container vessels ever built as a new record in size. The monsters are said to be of 18,000 boxes capacity or 2500 TEUs more than the *Emma Maersk* and each of these vessels will be 400m long, 59m wide and 73m high, making them the largest vessels of any type[2]. Sang-Tae Nam, Chief Executive of DSME, said the new vessels will be launched sometime between 2013 and 2015, he added: 'it will open a new chapter and change the landscape of shipping and shipbuilding.

We can add that this new record will also give another edge for ship repair industry, and create a new opportunity and challenge at the same time for the ship repair industry in Northeast Asian and European markets since these vessels will be deployed on the Asia-Europe trade.

Well, bigger is yet to come, *STX Shipbuilding* of South Korea reports it has completed the design of a 22,000 TEU containership that at 450 meters in length would be the longest ship to ply the oceans. Two alternative versions have been designed, one with a single propeller and the other with twin propellers. Compared to "Emma Maersk", the world's largest existing containership, the new design represents a 50% increase in capacity and some 50 meters extra in length. "The 22,000 TEU marks a breakthrough in the sense that the 20,000 TEU was once considered as the limit of a container ship can get in terms of its transport capacity both in terms of technology and economy," said STX in a statement. The current price of fuel is a major driver to bigger ships, added STX, and these new vessels could cut the shipping price per container by 40%[3].

[1] "Orders slide nearly 60%"-Tradewinds.no 2011
[2] "Maersk in a $5.7bn splash"-Tradewinds.no 2011
[3] "STX Reveals Designs for World's Largest Containership"-Seatrade-asia.com.2008.

Definitely, ship repair industry demand is driven by the physical need of maintaining the vessels in good order for trading when repair maintenance budget is available; the lonely cash source for ship owners is, however, is coming from freight earned, which makes repair time as an off-hire period that ship-owner wants to reduce to its maximum, and even defer class-dictated repair work to their maximum permitted time allowances, so the ship repair industry's fortunes finally mirror those of the shipping industry but with a lag time[4]. After sparkling years before 2008 and record sales for ship yards, the global crisis burst-out in September 2008, there has been no safe haven from the downturn, and the latest depression in ship repair revenues were combined to more capacity in repair facilities being delivered. Due to strong freight rates that ship industry enjoyed before crisis, so many ship-owners, wanted to secure their own repair facilities especially in China, among them Koreans, the first such yards, which opened its doors officially in July 2009, was the massive Dalian-based facility owned by Dayeang Shipping of South Korea. The Korean owner said that the 150millions US$ shipyard was first planned in 2006, amidst a strikingly different market that the one we see today[5].

More capacity from owners, this time South Korea's, largest owner Hanjing Shipping has

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[4] Ship Repair: A Drewry's Report on the Fundamentals of the Ship Repair Market. 2007
[5] "No safe Heavens"-Asia Maritime 2009
[6]"No safe Heavens"-Asia Maritime 2009
[7] "Ship Repair Crunch?" Jakub Walenkiewicz , Senior Market Analyst, DNV Market Research, 2009.
[8] "Yangzigiang Shipbuilding Builds China's Largest Drydock" Worldmaritimenews.com 2011.
[9] "*Sembawang secures Carnival contract*"-The Motor Ship, 2010.
[10] *"Orders slide nearly 60%* "-Tradewinds.no 2011.
[11] "The Interaction Between the Shiprepair, Ship Conversion, and Shipbuilding Industries" OECD 2008
[12] "The Interaction Between the Shiprepair, Ship Conversion, and Shipbuilding Industries" OECD 2008
[13] "Shipdock at full speed with repair work"- Lloyd's List 2008.
[14] "*Where to repair?"*-Marine log, July 2000.
[15] "21st Century Approach to Ship Maintenance and Repair"- N W Granger Executive Secretary of CESA.
[16] "China but no Crisis for Ship Repair"- The Maritime Journal, 2007.
[17]"India Ship Repair Industry"-Mantrana Maritime Advisory.
[18] "India Ship RepairIndustry"-Mantrana Maritime Advisory. ww.mantrana.in.
[19] "Managing Cyclical Change in the European Shipbuilding and Ship Repair Industries"-The European Foundation for the Improvement of Living and Working Conditions Report 2007.
[20] "An Analysis on the South-Korean Automotive, Shipbuilding, and Steel Industries" Amrik.S.Sohal, Bill Ferme. Quality Management &Technology Journal.Vol.3, Issue 2 pp.15-30.1996.
[21] "Orders slide nearly 60%"-Tradewinds.no 2011.
[22] Myung-Sin Ha "A Scheme of High Value-added Strategy of Port Related Industries in Busan" Korea International Commerce Review Vol.20.No.1 (2005/03)

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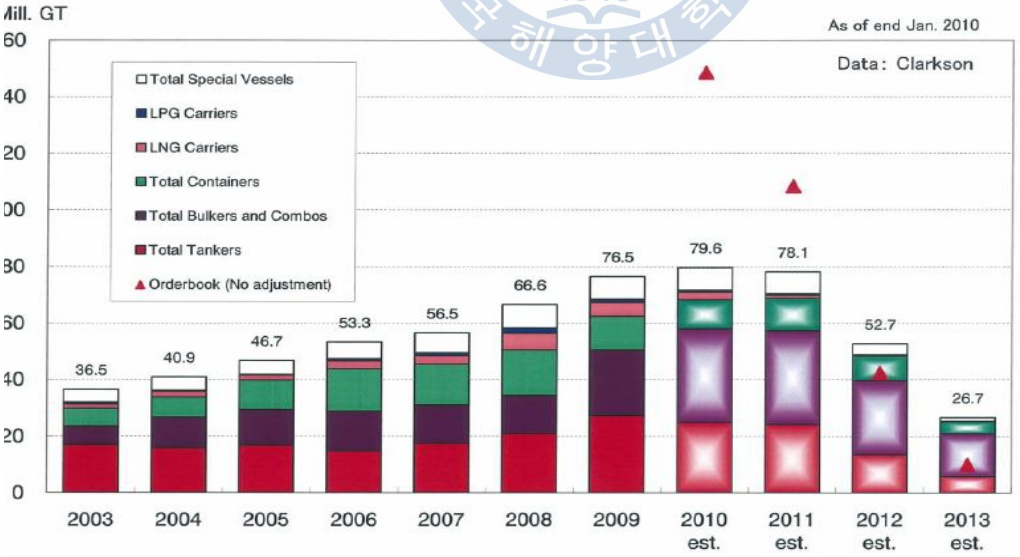
created one of the world's largest ship yards at Qushan Island in Zheijian Province, with 32% joint investment from Japanese major Kawasaki Kisen Kaisha and Shanghai Changjiang Shipping, part of the SINOTRANS Group.

The Korean owner argued that in accordance with the increase in their fleet, they needed to secure docks to repair their vessels under stable conditions considering the number of ships owned by the CKYH Alliance (COSCO, "K" Line, Yang Ming Line and Hanjin Shipping) partners and other major owners[6].

**Figure 2-2 Actual Delivery & Estimated Delivery by Ship Type**

**(As end of Jan 2010)**

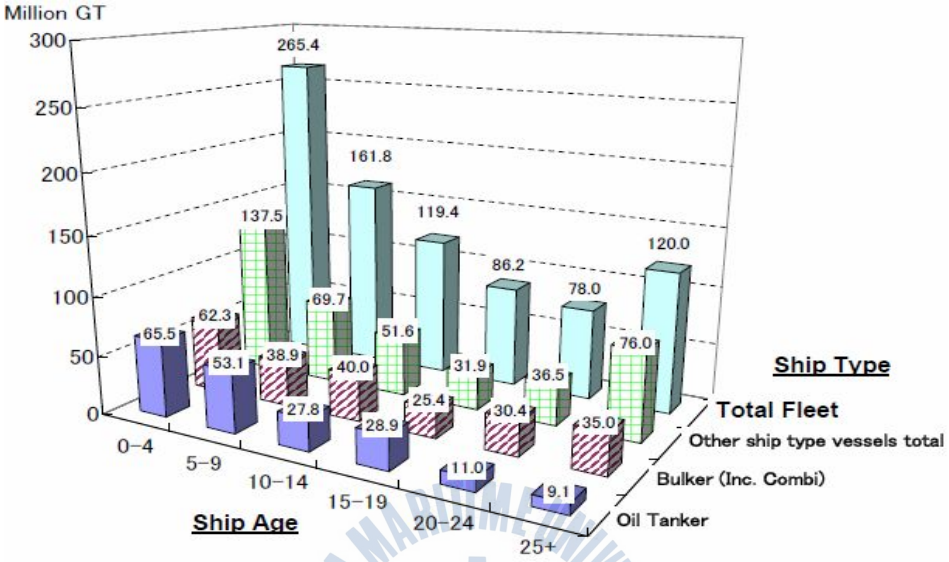



*Source : Shipbuilding Statistics-The Shipbuilders' Association of Japan, March 2010.*

**Figure 2-3 World Merchant Fleets' Age Profile by Ship Type**

***(100 Gross Tonnage and over)***

As end of 2008




*Source : Shipbuilding Statistics-The Shipbuilders' Association of Japan March 2010*

But, like Daeyang, Hanjin intends to add the assurance of an additional revenue stream by expanding the ship repair business to offshore and FPSO units.

While little can be said about the total demand for ship repair and maintenance services, it has been reported by *Worldyards Research* that the demand for dock space to carry out the five year statutory dry-dock cycles for big ships (which require dry-docking) is expected to rise rapidly through to 2015, as shown in Table 2-1.Based on the steeply increasing demand for such services (more than 100% between 2007 and 2015), it might be possible to speculate that there will be pressure on repair yard capacity, especially if some of that capacity has been converted to either conversion or newbuilding work, to take advantage of the very high demand and high prices for those services. Even china arrived in force in ship repair industry expanding the supply side; it seems that many Chinese operators view repairs merely as a milestone on the way to becoming shipbuilders, albeit the trend should be to the increasing newbuilding orders, which is not the case right now. The world order book is shrinking coinciding with more capacity that has been developed in other regions of the world in Eastern Europe, Malaysia, Vietnam, the Philippines and in the Middle East.

So many reports and forecast studies have been issued trying to predict the demand for the ship repair industry. According to a major in depth report from UK-based *Ocean Shipping Consultants Ltd*, which title was "*The World Ship Repair Market to 2015*" (released in 2002), the international ship repair industry is said to be entering a period of extensive change and uncertainty-based on the development of new ship repair facilities in Asia and the inter-action of a number of factors impacting directly on the demand for ship repair services such as the IMO regulations on single-hull tanker phase-out. Overall, the outlook was set for underlying demand growth, subject to market short-term variation and a considerable change in the profile of supply.

Another study from DNV in 2007[7] in order to develop a future scenario for the ship repair demand, the findings were more optimistic for demand and diagnosed a crunch of supply of course on the basis of high freight rates and a busy ship building order book.

For the short term , demand will be hardly seen to increase , combined to an over capacity and a mounting competitive pressures are more elements that can just tell that hard times may be coming for global ship repair industry, and only yards which will take advantage of the opportunities by adjusting to more efficient technology and managerial skills can survive.

**Table 2-1 Scheduled Ship Repair Demand Estimates 2007-2015**

| Segment | Anniversaries (multiple of 5s) | Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
| Large Bulker | 5th | 34 | 23 | 33 | 44 | 54 | 65 | 57 | 39 | 107 | 161 |
| | 10th | 50 | 46 | 12 | 30 | 33 | 34 | 23 | 33 | 44 | 54 |
| | 15th | 19 | 23 | 31 | 29 | 39 | 50 | 46 | 12 | 30 | 33 |
| | 20th | 31 | 22 | 9 | 15 | 38 | 19 | 23 | 31 | 29 | 39 |
| | 25th | 28 | 30 | 9 | 17 | 20 | 31 | 22 | 9 | 15 | 38 |
| | *Total* | *162* | *144* | *94* | *135* | *184* | *199* | *171* | *124* | *225* | *325* |
| Large Container | 5th | 57 | 43 | 38 | 47 | 58 | 101 | 72 | 97 | 88 | 107 |
| | 10th | 20 | 21 | 17 | 14 | 35 | 57 | 43 | 38 | 47 | 58 |
| | 15th | 0 | 0 | 0 | 0 | 8 | 20 | 21 | 17 | 14 | 35 |
| | 20th | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| | 25th | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 |
| | 30th | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Total* | *77* | *64* | *60* | *61* | *101* | *178* | *136* | *157* | *149* | *208* |
| Large Tanker | 5th | 58 | 95 | 139 | 109 | 120 | 98 | 117 | 125 | 239 | 155 |
| | 10th | 46 | 39 | 68 | 95 | 85 | 58 | 95 | 139 | 109 | 120 |
| | 15th | 64 | 82 | 77 | 49 | 46 | 46 | 39 | 68 | 95 | 85 |
| | 20th | 31 | 26 | 29 | 42 | 40 | 63 | 82 | 77 | 49 | 46 |
| | *Total* | *199* | *242* | *313* | *295* | *291* | *265* | *333* | *409* | *492* | *406* |
| LNG | 5th | 1 | 10 | 14 | 21 | 18 | 26 | 32 | 53 | 55 | 17 |
| | 10th | 6 | 5 | 3 | 6 | 12 | 1 | 10 | 14 | 21 | 18 |
| | 15th | 1 | 1 | 4 | 8 | 5 | 6 | 5 | 3 | 6 | 12 |
| | 20th | 0 | 0 | 0 | 3 | 2 | 1 | 1 | 4 | 8 | 5 |
| | 25th | 7 | 1 | 3 | 4 | 1 | 0 | 0 | 0 | 3 | 2 |
| | 30th | 3 | 8 | 6 | 5 | 3 | 7 | 1 | 3 | 4 | 1 |
| | 35th | 0 | 0 | 1 | 1 | 1 | 3 | 8 | 6 | 5 | 3 |
| | *Total* | *18* | *25* | *31* | *48* | *42* | *44* | *57* | *83* | *102* | *58* |
| Grand Total | | 456 | 475 | 498 | 539 | 618 | 686 | 697 | 773 | 968 | 997 |
| Annual Rate of Growth | | - | 4.17% | 4.84% | 8.23% | 14.66% | 11.00% | 1.60% | 10.90% | 25.23% | 3.00% |
| Accumulative Growth 2007-2015 | | | | | | | | | | | 109.89% |

*Source: WORLDYARDS 2007.*

## 2.2 Ship Repair Industry in the North East Asia Region

### 2.2.1 Ship Repair Industry in China

Similarly to many other economic sectors in China, ship repair industry has been through sustained development during the last 30 years. China has become a large ship repair country where there has been a significant investment in new dry-docks and repair facilities. After the reform and opening up, ship repair enterprises in Liaoning, Tianjin, Shandong, Jiangsu, Zhejiang, Fujian and Guangdong, etc are being expanded and strengthened continuously. The regional competition of Chinese ship repair industry concentrates in three regions – the Bohai Bay Rim centering on Dalian, Yangtze River Delta centering on ZhouShan and the Pearl River Delta centering on Guangzhou.

The scale of the industry went also larger, the first 150,000 tons dock in China was built by Guangzhou Wenchong Shipyard Co., LTD and then the 300,000 tons dock was built by

Shanhaiguan Shipyard. COSCO Shipyard and China Shipping International Shipyard Co., LTD even built a 300,000-ton floating dock.

The Chinese ship repair industry has developed rapidly the last decade, as of 2008 and as one of the signs of the Chinese repair yard transformation, there have been 29 VLCC docks, whereas before 2002 there were only 3 docks as shown in following table.

**Table 2-2 VLCC Docks in China 2008**

| Yard name | Before year 2002 | Year 2002-2007 | Planned | Ownership |
|---|---|---|---|---|
| Behai | - | - | 2 (2008) | State owned |
| Bohai | - | 1 | 1 | State owned |
| Cosco Dalian | - | 1 | - | State owned |
| Cosco Zhoushan | | 1 | 1 (2008) | State owned |
| Dalian New yard | 1 | 2 | - | State owned |
| Dalian yard | - | 1 | - | State owned |
| Guangzhou Long Xue | - | 2 | - | State owned |
| Jiangnan Changxing | - | 4 | - | State owned |
| Jinhaiwan | - | 2 | - | Private |
| NACKS | 1 | 1 | - | Private |
| Nantong Rongsheng | - | 3 | 1 (2008) | Private |
| New Century | - | 2 | | Provincial |
| Hudong Zonghua | - | 1 | - | State owned |
| Qingdao Beihai | - | 2 | - | State owned |
| SWS | - | 2 | - | State owned |
| Yantai Raffles | 1 | - | - | Private |
| Total | 3 | 25 | 4 | |

*Source: BRS 2008*

By the end of 2008, the reserving volume of 50,000-ton and above repair dock in China reached 59 with a capacity of near 8.39 million tons. The repair volume of major ship repair enterprises came to about 5,310 vessels, roughly 100 million DWT. Up to 2009, the docking capacity has achieved 8 million tons and the capacity of large docks has exceeded that of Singapore.

Yangzigiang Shipbuilding (Holdings) is set to own the largest dry-dock in China as the Singapore-listed company, which holds a 60% stake in Yangzi Xinfu Shipbuilding, is building a 543 m by 147 m dock that will be ready from 2013. The new dock will overtake Hong Kong-Listed Ronsheng Heavy Industries' No 4 dry-dock, which measures 530 m by 135 m and is currently the largest of its kind in the country[8].

For the overall financial performance, as Influenced by the financial crisis, and according to a major research report on Chinese Ship repair industry released in July 2010 Chinese ship repair industry sustained depression in 2009. Specifically, since the second half of 2008, not only the ship repair industry but also the ship building industry has been severely affected by the global financial crisis. In 2009, both the output value and the number of ships repaired have seen a year-on-year slump of 30 %.

As orders shrank, and according to the same report, prices dropped, the average plate renewing price was reduced from 2,800-2,900 USD/ton at the end of September 2008 to 1,000 USD/ton or even 900 USD/ton, approaching the record low. Other foreign yards in the region, keep from tendering due to this very low prices when Chinese yards have already tendered, especially for steel work.

In 2009, the market scale of Chinese ship repair industry was about CNY 57 billion, dropping by about 5% Year-On-Year. It is clear that the competitive advantage of Chinese ship repairers is benefiting from low currency exchange advantages and abundant local cheap labor. The modernized development of Chinese industry is in the primary stage at present. However, the labor-intensive advantage is being replaced gradually by technology and capital intensive advantages and will predictably drain more international and domestic investment.

### 2.2.2 Ship Repair Industry in Singapore

Today, Singapore is renowned for being the World's most comprehensive and competitive ship repair and ship conversion center as well as a global leader in the building of jack-up rigs and the conversion of FPSO (Floating Production Storage and Offloading) units. It is also a niche player in the construction of customized and specialized vessels.

Singapore has been evolving into a one-stop marine centre for ship owners, managers and

agents around the world. Generating an annual turnover of close to $10 billion and employing some 100,000 workers, the marine industry plays a crucial part in Singapore's economic growth where Ship repair and conversion form the backbone of the local marine industry, accounting for more than half of the total revenue.

Ship repair in Singapore started its international career since the 1980s and since then was gradually established as a major international ship repair centre, particularly for larger vessels until the 2000s where it started to significantly lose market shares to Chinese shipyards in the general repairs market. Singaporean players are working on maintaining competitive advantage by hiring cheap labor from neighboring Asian countries.

According to the *Association of Singapore Marine Industries* in its Report about the Singapore's ship repair and Conversion sector 2009, there was a slowdown in demand for ship repair and conversion projects in 2009 as a result of the economic recession and corresponding decline in seaborne trade. Nonetheless, the local shipyards enjoyed a steady base load of ship repair projects secured under the favored customer contracts and evergreen alliance partnerships with key customers. Such alliances helped to ensure a steady flow of vessels into the local docks for repairs.

Output from the ship repair sector grew slightly to S$6,733 million. This was S$265 million or 4% more than the S$6,468 million achieved in 2008 or 40% of the industry's total output.

Port statistics from the Maritime and Port Authority of Singapore (MPA) showed an increase in the number of vessels calling in Singapore for ship repair during 2009. A total of 7,200 vessels called in Singapore for repairs in 2009. This was 9.3% or 612 vessels more than the 6,588 vessel calls recorded in 2008.

However, the total gross tonnage of the vessels that called in Singapore for repairs in 2009 was lower. The total gross tonnage of 37.83 million GRT in 2009 was 12.6% lower than that of 43.26 million GRT recorded in 2008.

Ship repair industry in Singapore, even facing a strong competition from low cost Chinese shipyards, is still maintaining their dominant position in the area, especially for high value projects such as LNG and cruise vessels repairs. The industry in Singapore is also having a very strong marketing policy by clinching long term contracts from big owners. Last year

Sembawang Shipyard was committed to the repairs, refurbishment and upgrading of Carnival's passengers ships that cruise in the Far East[9].

**Table 2-3 Singapore Marine Industry Total and Sectorial Turnover 2009**

**(in S$Billion)**

| YEAR | TOTAL TURNOVER | SHIP REPAIR SECTOR | SHIPBUILDING SECTOR | OFFSHORE SECTOR |
|---|---|---|---|---|
| 1998 | 3.86 | 1.99 | 0.92 | 0.95 |
| 1999 | 3.12 | 2.16 | 0.44 | 0.52 |
| 2000 | 2.76 | 1.68 | 0.45 | 0.63 |
| 2001 | 4.03 | 2.56 | 0.54 | 0.93 |
| 2002 | 4.40 | 2.73 | 0.53 | 1.14 |
| 2003 | 3.79 | 2.29 | 0.72 | 0.78 |
| 2004 | 5.30 | 3.10 | 0.90 | 1.30 |
| 2005 | 7.43 | 3.79 | 1.26 | 2.38 |
| 2006 | 9.80 | 4.90 | 1.67 | 3.23 |
| 2007 | 13.05 | 6.26 | 1.83 | 4.96 |
| 2008 | 16.80 | 7.06 | 1.67 | 8.06 |
| 2009 | 16.83 | 6.73 | 0.84 | 9.26 |

*Source: Association of Singapore Marine Industries. Singapore Marine Industry Annual Report*

**Table 2-4 Singapore Repair Yards Docking Capacity (As at February 2010)**

| CAPACITY | NO. OF DOCKS | TOTAL DEADWEIGHT TONNES |
|---|---|---|
| 5,000 | 1 | 5,000 |
| 7,500 | 1 | 7,500 |
| 10,000 | 1 | 10,000 |
| 100,000 | 2 | 200,000 |
| 150,000 | 1 | 150,000 |
| 170,000 | 1 | 170,000 |
| 200,000 | 1 | 200,000 |
| 300,000 | 2 | 600,000 |
| 330,000 | 1 | 330,000 |
| 360,000 | 1 | 360,000 |
| 400,000 | 2 | 800,000 |
| 500,000 | 1 | 500,000 |
| TOTAL | 15 | 3,332,500 |

*Source: Association of Singapore Marine Industries Singapore Marine Industry Annual Report, 2011.*

The major repair yards in Singapore are the following:

1-Juron Ship yard is a subsidiary owned by the SembCorp Marine, the marine engineering arm of SembCorp Industries specializing in ship repair, shipbuilding, ship con-version and off-shore engineering.

| DOCK | SIZE | CAPACITY |
|---|---|---|
| DD1 | 270m x 40m x 10m | 100,000 dwt |
| DD2 | 350m x 56m x 12m | 300,000 dwt |
| DD3 | 380m x 80.2m x 14m | 500,000 dwt |
| DD5 | 335m x 56m x 11m | 200,000 dwt |
| | **Total** | 1,100,000 dwt |

*Source: jspl.com (Accessed February 2011).*

2-Keppel Shipyard owned by the Keppel Corporation headquartered at Singapore, Keppel Shipyard is now the world leader in the conversion of FPSO, FSO and FSRU, having

delivered more than 85 such projects since 1981. It also has a proven track record for LNG repairs and conversions.

:

| Facilities | Type | Dwt | Length (M) | Breadth (M) | Draft (M) |
|---|---|---|---|---|---|
| **Drydock** | Tuas Dock | 360,000 | 350 | 66 | 6.6 |
| | Raffles Dock | 330,000 | 355 | 60 | 6.6 |
| | Temasek Dock | 150,000 | 301 | 52 | 7.4 |

*Source: Keppel.com (Accessed February 2011).*

3-Sembawang Shipyard founded in 1968, operates as a subsidiary of SembCorp Marine Ltd. Based in Singapore with facilities in Indonesia, the company offers afloat and anchorage repair services, offshore and conversion services; rig upgrading and new building services and steelwork. It repairs and refurbishes various vessels, such as tankers, chemical tankers, LNG carriers, luxury cruise liners, bulk carriers, ore/bulk/oil carriers, cargo ships, containerships, and offshore vessels.

| Docks | Type | Length(m) | Capacity (DWT) |
|---|---|---|---|
| **Premier** | Graving | 384.0 | 400,000 |
| **President** | floating | 290.0 | 150,000 |
| **KG-VI** | graving | 303.0 | 100,000 |
| **Republic** | Floating | 202.3 | 60,000 |
| **KFD** | Floating | 230.0 | 65,000 |

*Source: Sembship.com (Accessed February 2011).*

## 2.2.3 Ship Repair Industry in Japan

Japan ship repairs industry enjoys both a large infrastructure which can manage vessels up to 500,000 dwt (Table 2-5) and a strategic position in one of the world's busiest trade lanes between East and West.

However, Japan's ships repair and shipbuilding industry after enjoying a prosperous period up to the 1990s has seen its competitiveness falling down following its dominance in the 1970s and 1980s, due to higher labor costs, to the competition in Singapore and China.

This situation is chiefly due to the strength of the Japanese Yen, price levels in Japan being 200/250% higher than Singapore. Since then Japan as the world's 2nd shipping nation power in terms of ownership, is more than ever focusing on domestic niche market where it can maintain its competitiveness for high efficiency and automation requiring jobs, the main work comes from domestic large LNG carriers, who have long term agreements with yards with particular expertise in the LNG trade (both building and repair of containment systems) (Table 2.6).

Same pattern is seen in shipbuilding industry where Japan, as of February 1st 2011, is maintaining a third position after Korea and China with an order book worth US$ 56.5bn for 1,096 ships amounting to 80.4 mdwt[10]. Also according to the shipbuilders association of Japan in a statistical report on Shipbuilding released in march 2010, Japanese yards repair sales has been shrinking to a marginal 5 % share in 2008 in the shipbuilding & ship repair industry total sales from more than 20% sales share registered in the 1980s (Table 2.7).

**Table 2-5 Japan Main Ship Repair Yards**

| Shipyard's name | Facility Type | LxBxD (m) | Capacity DWT |
|---|---|---|---|

| | | | |
|---|---|---|---|
| IHI Aichi Shipyard | D.D | 350x90 | |
| IHI Amtec Co-Aioi | D.D | 340x54.5 | |
| IHI Marine United-Kure Shipyard | D.D | 318x41.8 | |
| Koyo Dockyard | D.D | 350x 6 | |
| Koy Dockyard | D.D | 350X45 | 140,000 |
| Tsuneishi Shipbuilding | D.D | 310x48.8 | |
| Kawasaki shipbuilding-Sakaide Shipyard | D.D | 430x69 | |
| Mitsubishi H.I | D D | 375x70 | 500,000 |
| Mitsubishi H.I | D.D | 335x54 | 300,000 |
| Sarioyas Hishino Meisho | D.D | 675x63 | |
| Sasebo Heavy Induustries | D.D | 360x69 | |
| IHI Marine United-Yokohama Shipyard | D.D | 320x54 | |
| Mitsubishi H.I | D.D | 331x55 | 270,000 |
| Mitsui E&S-Yura Works | D.D | 350x65 | 330,000 |
| Universal Shipbuilding Co. -Tsu Shipyard | D.D | 470x72 | |

*Source: The Motor ship 2002*

**Table 2-6 Japan Ship Repair Industry-Domestic/Foreign Vessels 1997-2006**

| Year | Domestic vessels | | Foreign vessels | |
|---|---|---|---|---|
| | No. | Sales (mil JPY) | No. | Sales (mil JPY) |
| 1997 | 31,094 | 150,955 | 1,697 | 27,995 |
| 1998 | 29,494 | 162,105 | 1,598 | 25,860 |
| 1999 | 28,605 | 110,804 | 1,598 | 24,568 |
| 2000 | 26,821 | 101,960 | 1,460 | 19,714 |
| 2001 | 26,130 | 94,861 | 1,403 | 22,784 |
| 2002 | 23,477 | 87,220 | 1,145 | 23,194 |
| 2003 | 21,505 | 120,107 | 967 | 18,610 |
| 2004 | 20,353 | 135,724 | 1,135 | 23,728 |
| 2005 | 19,003 | 79,309 | 944 | 21,162 |
| 2006 | 18,681 | 78,251 | 823 | 26,152 |

*Source: Japan Ministry of Land, Infrastructure and Transport.*

**Table 2-7 New building / Repair Sales**

**(Shipbuilders' Association of Japan Members Only)**

( Unit : 100 Million Yen

| Fiscal year | Newbuilding | share(%) | Repair | share(%) | Total | No. of company |
|---|---|---|---|---|---|---|
| 1975 | 16,453 | 89.5 | 1,920 | 10.5 | 18,373 | 23 |
| 1976 | 18,374 | 90.7 | 1,890 | 9.3 | 20,264 | 23 |
| 1977 | 17,989 | 89.5 | 2,103 | 10.5 | 20,092 | 23 |
| 1978 | 9,906 | 84.2 | 1,856 | 15.8 | 11,762 | 23 |
| 1979 | 8,877 | 81.2 | 2,052 | 18.8 | 10,929 | 23 |
| 1980 | 10,750 | 76.0 | 3,395 | 24.0 | 14,145 | 23 |
| 1981 | 14,514 | 79.5 | 3,740 | 20.5 | 18,254 | 23 |
| 1982 | 13,412 | 82.0 | 2,941 | 18.0 | 16,353 | 23 |
| 1983 | 14,820 | 86.1 | 2,385 | 13.9 | 17,205 | 23 |
| 1984 | 15,249 | 86.7 | 2,347 | 13.3 | 17,596 | 23 |
| 1985 | 12,067 | 84.5 | 2,206 | 15.5 | 14,273 | 23 |
| 1986 | 9,800 | 84.9 | 1,737 | 15.1 | 11,537 | 18 |
| 1987 | 5,448 | 76.7 | 1,658 | 23.3 | 7,106 | 18 |
| 1988 | 5,086 | 76.7 | 1,542 | 23.3 | 6,628 | 18 |
| 1989 | 7,279 | 80.2 | 1,796 | 19.8 | 9,075 | 18 |
| 1990 | 8,665 | 82.7 | 1,817 | 17.3 | 10,482 | 18 |
| 1991 | 8,990 | 82.1 | 1,961 | 17.9 | 10,951 | 18 |
| 1992 | 11,780 | 88.3 | 1,567 | 11.7 | 13,347 | 18 |

| Fiscal year | Newbuilding | share(%) | Repair | share(%) | Total |
|---|---|---|---|---|---|
| 1993 | 12,288 | 88.9 | 1,529 | 11.1 | 13,817 |
| 1994 | 11,789 | 88.6 | 1,518 | 11.4 | 13,307 |
| 1995 | 10,378 | 87.3 | 1,515 | 12.7 | 11,893 |
| 1996 | 11,453 | 88.6 | 1,480 | 11.4 | 12,933 |
| 1997 | 12,247 | 88.6 | 1,577 | 11.4 | 13,824 |
| 1998 | 13,141 | 90.4 | 1,397 | 9.6 | 14,538 |
| 1999 | 11,768 | 90.4 | 1,249 | 9.6 | 13,017 |
| 2000 | 11,820 | 90.3 | 1,276 | 9.7 | 13,096 |
| 2001 | 12,240 | 91.1 | 1,201 | 8.9 | 13,441 |
| 2002 | 12,128 | 91.3 | 1,157 | 8.7 | 13,285 |
| 2003 | 12,202 | 91.8 | 1,094 | 8.2 | 13,296 |
| 2004 | 13,122 | 92.8 | 1,024 | 7.2 | 14,146 |
| 2005 | 13,891 | 91.9 | 1,227 | 8.1 | 15,118 |
| 2006 | 15,485 | 93.1 | 1,140 | 6.9 | 16,625 |
| 2007 | 20,072 | 93.6 | 1,378 | 6.4 | 21,449 |
| 2008 | 21,974 | 94.5 | 1,289 | 5.5 | 23,264 |
| 2009 | 25,529 | 95.9 | 1,079 | 4.1 | 26,608 |

*Source: Shipbuilders Association of Japan (SAJ) March 2010.*

## 2.3 Ship Repair Industry in Europe

North-west Europe repair yards have been by excellence the world's ship repair centre for decades in the last century. But most famous World renowned ship repair centers in Rotterdam, Hamburg and on the Mediterranean sea (France, Spain) and on the Atlantic (UK, Portugal) began to lose their competitive advantage first time to lower cost repairers in Singapore, China and the Middle East and then to their fellow European yards in Eastern Europe, the Baltic Sea and Turkey,

that nowadays there is a little doubt that the centre for global ship repair industry will one day move back to the North European yards, while they are also struggling with very low

competitiveness for shipbuilding unless for technically high specialized vessels .

Under the pressure of this fierce competition, since the 1990s traditional ship repair yards turned to focus on intra-regional markets, as well as more complex conversion and specialist activities. They also had gone through painful privatization, restructuring and shifted to a more flexible work practices encompassing a greater degree of subcontracted work. Emphasis on quality, expertise, and tight scheduling has also helped bolster repair/conversion activity among some European yards (OCDE 2008).

European Repair facilities based in the Mediterranean are also facing increased competition from expanding yards in the Black Sea, as well as yards in Asia on inter-regional trading routes with owner's preference for Asian shipyard offering cheaper prices. Whilst it is expected that general repair work, on relatively small vessels in the regional market, will continue to form the core of Mediterranean yard activity, a number of those yards are expanding into more specialist services, such as the focus by the Italian Fincantieri group on repair/conversion (particularly for cruise vessels) at its dedicated yard in Palermo[11]. Same pattern for other French shipyards in the Marseille city and on the Atlantic, which enjoying some 'legacy' that keeps them active in the specialized world of cruise and passenger ships.

The opening up of Central and Eastern Europe since the early 1990s has added to the supply of repair/conversion facilities, especially as state owned facilities have been progressively privatized, thus enabling them to greatly increase the range of services offered[12] and drain fresh capital. While these new yards brought a measure of low cost competition in the European scene it appears that some are already losing their cost advantages to newer entrants, and it was reported in Lloyd's List[13] that ship owners are often weighing up sailing times if they are considering Baltic or Polish yards, since it could be more economical to have maintenance and repairs done closer to their main trade routes. Without doubt the cheapest yards where to repair are the Baltic and the Balkan states. Both regions have been working on to increase their presence on the international market. In the Baltic sea, Poland was the first to move into the international market, with general repairs and conversions regularly undertaken by the various yards, especially in the large facility of Remontanawa SA in Gdansk. Since then, yards in Russia, Lithuania, Latvia and Estonia

have joined in the fray with even more lower steel prices compared with those in Poland, northern Germany and Scandinavia[14].

**Table 2-8 Eastern Europe Main Ship Repair Yards**

| Country | Shipyard name | Facility Type | LxBxD (m) |
|---|---|---|---|
| Poland | Gdynia Shipyard S.A | D.D | 380x70 |
| Romania | Santerul Naval Constania | D.D | 350x58 |
| | Santerul Naval Constania | D.D | 350x48 |
| | Daman Shipyard Galatik | D.D | 460x34 |
| | Daewoo Mangalia Heavy Industries | D.D | 328x48 |
| | Daewoo Mangalia Heavy Industries | D.D | 300x48 |
| | Daewoo Mangalia Heavy Industries | D.D | 360x60 |
| Turkey | Pendik Naval Shipyard | D.D | 300x70 |
| | Tuzia Shipyard | F.D | 350x65.7 |
| Finland | Helsinki Repair Yard | D.D | 380x56 |

*Source:* The Motor Ship 2002

**Table 2-9 Western Europe Main Ship Repair Yards**

| Country | Shipyard name | Facility | LxBxD (m) |
|---|---|---|---|
| Germany | Lloyd Werf Brerezhaven | D.D | 335x35 |
| | Blohm & Voss Repair | D.D | 351.2x59.2 |
| | Blohm & Voss Repair | F.D | 302x52 |
| | Howaidtswerke Deutsche wreft | D.D | 426x88.24 |

| | | | |
|---|---|---|---|
| | Howidtswerke Deuttsche wreft | D.D | 312.8x50.25 |
| | Meyer Werft | D.D | 375x12 |
| | Meyer Werft | D.D | 370x101.5 |
| | Aker MTW Wert | D.D | 340x67 |
| France | Sobrena | D.D | 338x55 |
| | Sobrena | D.D | 420x80 |
| | Arno Dunkerque | D.D | 310x50 |
| | Port Autonome du Havre | D.D | 319x38 |
| | Port Autonome du Havre | F.D | 310x53 |
| | Chantiers de L'Atlantique | D.D | 415x63 |
| | Port Autonome de Marseille | D.D | 465x84 |
| | Port Autonome de Marseille | D.D | 320x50 |
| U.K | Harland & Wolff Heavy Industries | D.D | 56x93 |
| | Harland & Wolff Heavy Industries | D.D | 335x50.29 |
| | Clydeport Ltd | D.D | 304x44 |
| | A&P (Southampton) | D.D | 365x41.4 |
| | Babcook Rosyth Defence | D.D | 312x35 |
| | Babcook Rosyth Defence | D.D | 300x32 |
| Netherland | Keppel Verolme BV | D.D | 05x90 |
| | Rotlerjam United Shipyard | D.D | 307.37x46.06 |
| Portugal | Lisnave | D.D | 450x75 |
| | Lisnave | D.D | 420x75 |
| | Lisnave | D.D | 350x55 |
| Belgium | Antwerp Shprepair | D.D | 312x50 |
| Spain | Izar Carenas Cadiz | D.D | 386.8x66.6 |
| | Izar Carena Ferrol-Fene | D.D | 330x50 |
| Italy | Cantiere Navale Frateli (Orlando) | D.D | 350x56 |
| | Cantieri del Mediterraneo | D.D | 335x40 |
| | Fincanitieri Palermo | D.D | 370x68 |

*Source:* The Motor Ship 2002

According to CESA, the Community of European Shipyards Associations, the turnover for the maintenance, repair and conversion yards, CESA, record just over €2.5bn in 2005, over

€3bn in 2006; €3.5bn in 2007; and a peak of over €4bn in 2008. Not surprisingly, there was a drop back to just under €3.5bn in 2009 due to the global crisis in shipping. 2008 was then, the best year ever for maintenance and conversion yards in Europe[15].

## 2.4 Ship Repair Industry in Other Regions

### 2.4.1 Middle East

The Middle East, with China, is probably one of the most important regions where ship repair industry is growing very fast; particularly in the UAE and Bahrain; there has been considerable investment in facilities and the importation of labor from low cost regions such as India, Pakistan and the Philippines, to build up a competitive ship repair industry. The yards at Dubai and Bahrain have a strategic position and are able to capture many of the tanker vessels that converge there, as well as ships supplying commodities to the Gulf States.

It has been reported by Lloyd's List that construction of the Ras Laffan ship repair yard Project in Qatar is making tangible progress, with the 43ha repair yard primarily focusing on servicing LNG carriers. However, the intention is that it will also service and repair a wide range of vessels, as well as conversion of tankers to FPSO and FSOs.

The Middle East is also a strategically important region for vessel maintenance and repair activity, covering the full range of vessel types. Yards such as Dubai Drydocks and ASRY (Arab Ship Repair Yard) of Bahrain are to the forefront of the industry, but other facilities such as Basrec in Bahrain and Abu Dhabi Shipbuilding have a significant local role to play.

There are also some interesting new yard development projects in progress in the Middle East, including the development of Dubai Maritime City (DMC), expected to be fully operational by 2012, will replace the long established Jadaf complex in Dubai. There are other larger yard investments underway in Qatar and Oman.

The focus of DMC is on repairs to small and medium sized craft, including tugs, offshore

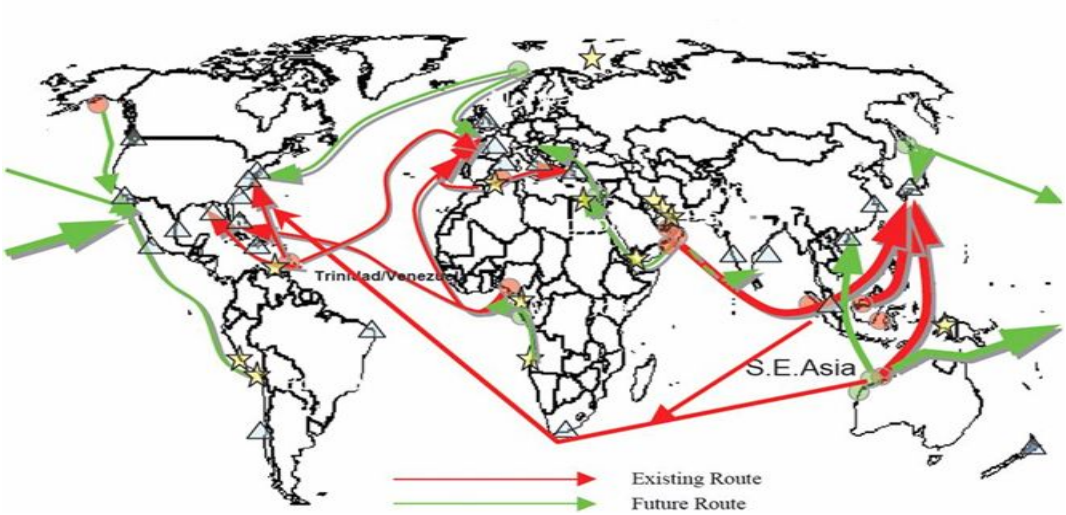
support vessels, dredgers, vessels used on intra-Gulf trade routes, as well as yachts and leisure boats. With the booming Middle East construction and offshore markets creating strong demand, the opening of this impressive new facility seems particularly well timed[16].

On a percentile scale, if the cost of ship repair in the Middle East is set at 100, costs are estimated to be 250 in Japan, 150 in Europe and 50 in China. However, for tankers and LNG carriers servicing, we can see a huge potential for the Middle East region since it's a busy trade lane for these two commodities worldwide (Fig 2.4 & 2.5).

**Figure 2-4 Global Oil Export Trade Routes**


*Source: worldpress.com (Accessed February 2011)*

**Fig 2-5 World LNG Trade Routes**




*Source: Lngpedia.com-(Accessed February 2011)*

## 2.4.2 India

While India has not traditionally been considered as a ship repair/conversion centre (except for domestic users) despite its strategic position, it is clear that Indian Government is aspiring to upgrade the ship repair industry and it has been published in the report "*Working Group for Indian Shipbuilding and Ship Repair Industry for the Eleventh Five Year Plan (2007-2012*)" by the Government, that the existing docking facilities had not grown to meet the requirements of modern tonnage. This meant that with the commencement of new refineries on the Indian coast, the number of VLCC's used on those trades is bound to increase, with growing potential for the docking of such vessels. Moreover, it has been reported in this report that the vicinity of Gujarat to the adjacent Middle East oil fields could also attract substantial tanker repair business (IMS 2007).

India is strategically located in the Indian Ocean and hence, many ships from the nearby trade routes call on Indian ports. This means that there is a lot of potential for ship repair industry in India**.** However, currently ship repair for these is primarily undertaken in Dubai Dry docks, Singapore, Bahrain and Colombo dockyards.

There is an increasing market potential for the ship repair business in India, as ship owners

prefer to repair their ships without deviating from their trade routes as much as possible. But due to lack of infrastructure and focus, the ship repair industry is not able to reap the benefits.

Another reason for high repair potential is the age profile of Indian fleet. Almost half of the Indian flag fleet is older than 20 years. Older ships require more frequent and extensive repairs and maintenance.

The major repair yards in India are Cochin Shipyard Ltd (CSL), Hindustan Shipyard Ltd (HSL), Western India Shipyard, Mazagaon Dock Ltd. Western India shipyard is the only shipyard, which is dedicated to ship repairing activity. Other shipyards usually have shipbuilding and repair facilities in the same time.

The largest dry docking capacity in India belongs to Cochin Shipyard (125,000 DWT) followed by Hindustan Shipyard (74,000DWT)[17].

**Table 2-10 India's Main Ship Repair Yards**

| Shipyard name | Location | Capacity DWT |
|---|---|---|
| Cochin shipyard | Kochi | 110,000 |
| Hindustan Shipyards | Vishakhapatnam | 80,000 |
| Hooghly Dock & Port Engineers | Kolkata | 15,000 |
| Central Inland Water Transport Corp. | Kolkata | |
| Mazgaon Dock | Mumbai | 27,000 |
| Garden Reach Shipbuilders & Engineers | Kolkata | 26,000 |
| Goa Shipyard | Goa | 2,500 |
| Alcock & Ashdown Co. | Gujarat | 5,000 |
| The Shalimar Works | Kolkata | |
| ABG Shipyard | Gujarat | 35,000 |
| Baharati Shipyard | Maharashtra | 27,000 |
| Chowgule & Co. | Goa | 3,300 |
| Tebma Shipyards | Chennai | 2,250 |

*Source: Parag Parkish Financial Advisory Services Ltd.,Indian Shipbuilding Industry, 2008.*

In view of the uncertainty of shipbuilding beyond 2012, Indian shipyards are gearing up to tap into the ship repair market. Bharati Shipyard is set to carry out ship repairs using the

floating dock it acquired from Swan Hunter shipyard. With a view to realize its 11th five year plan targets, the government will look to fully utilize the 13 dry docks and 1 floating dock at the various port trusts. It is proposed that CSL and HSL be upgraded to world class standards[18].

## 2.4.3 Other Regions

Vietnam is the most significant of the recent entrants in the world's shipbuilding market, and is attracting considerable investment from foreign investors into its yards because of the support from the Vietnamese government, the availability of infrastructure and its large pool of skilled, low-cost labor. While it is understood that the majority of this foreign involvement is focused on newbuilding facilities, there will be an inevitable flow-on effect on other Vietnamese facilities; especially the older ones that may no longer be attractive for newbuilding construction, but which may find a niche by providing repair and conversion services.

The Vietnamese government is already moving things and in its plan for ship building and ship repair facilities upgrading plan 2020 is already in its second phase (2005-2010) has been concerned with the upgrading of Nam Trieu Shipyard up to 50,000 dwt; also in Dong Mai yard up to 30,000 dwt and in Dong-Quat Yard up to 100,000 dwt.

Other minor centers where ship repairs and conversions are undertaken exit around the world mainly focusing on local trade routes, many of these tend to be either high cost, domestically oriented, or lack the technical expertise to attract significant outside contracts. Australia/New-Zealand, Africa (especially South Africa) and central and South American facilities tend to fall into one of these categories.

US, ship repair industry continues to be focused on offshore and cruise ship work (the latter associated with the US and the Caribbean status as the world's largest cruise ship market).

**Table 2-11 Main Ship Repair Yards in the American Continent**

| Country | Shipyard name | Facility | LxBxD (m) |
|---|---|---|---|
| | Newport New Shipbuilding & Drydock | D.D | 662x76 |

| | | | |
|---|---|---|---|
| U.S.A | Newport New Shipbuilding & Drydock | D.D | 336x42 |
| | Kvaerner Philadelphia Shipyard | D.D | 332.8x45.7 |
| | Kvaerner Philadelphia Shipyard | D.D | 332.8x45.7 |
| | Metro Machine | D.D | 308.1x43.9 |
| | Nassco National Steel & Shipbuiling Co. | D.D | 304.8x51.8 |
| CANADA | Vancouver Shipyard | D.D | 347.67x38.4 |
| | Victoria Shipyards | D.D | 359.2x38.4 |
| BRAZIL | Sernetal Estalairos | D.D | 350x65 |
| PANAMA | Astilleros Braswell | D.D | 318x33.5 |

*Source: The Motor Ship 2002*

## 2.5 Opportunities and Challenges to World Ship Repair Industry

Shipowners know well that vessels cannot be traded continuously all year round, this is not more true than the fact that a maintenance free vessels can be one day built; it may be possible in theory but the cost would just not be commercially viable. On other hand, unfortunately, not all maintenance work can be handled onboard by the crew, thus the repair and maintenance services will be always needed by shipowners.

There has been a considerable change on the supply profile in the ship repair industry especially with the extensive development of ship repair facilities in Asia stressing too much on prices down. If it is the supply status right now, the demand side is not always as clear. In fact we can say that similarly to shipbuilding, ship repair industry is characterized by high cyclical feature; the cycles are entirely different in nature as regarding duration and frequency in the ship repair industry where cycles are considerably shorter and more frequent than in the shipbuilding industry that they can be seasonal for luxury cruise ships and even weekly changing in fishing vessels repairs. Thus, a key characteristic of the ship repair industry is the low visibility of the order book, while it's an important competitive element to give a more or less exact estimation of repairs lead time, the shorter the possible of course from the point of view of the shipowner to get back the vessel earning as soon as possible.

An important external factor that influences ship repair demand is the variations in freight

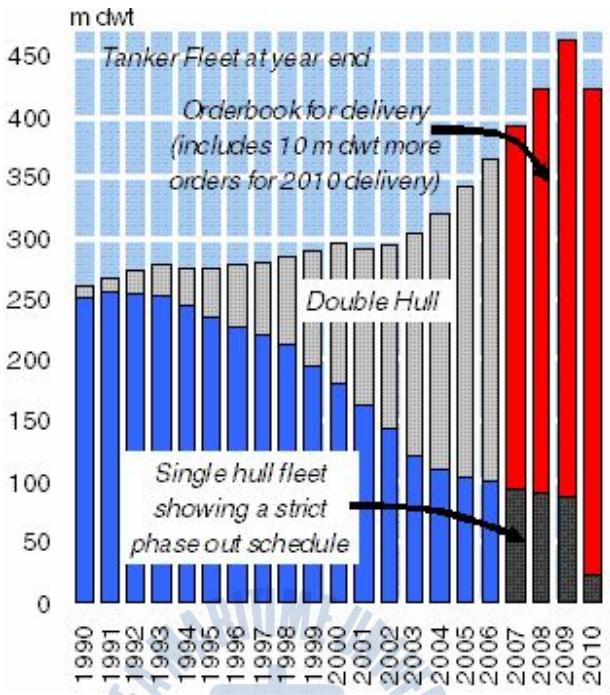
rates. Although a positive correlation might be seen between the development of freight rates and the money spent on repair and maintenance activities, in the short run high freight rates might have a negative impact on ship repair companies because many shipowners will be more likely to postpone repairs in order to take advantage of the favorable market conditions by minimizing off hire times. However, since repair and maintenance activities, especially class dictated ones, cannot be deferred indefinitely, increasing freight volumes might, in the medium and long term have positive impact on ship repair companies.

Of crucial importance in ship repair industry are the internal factors of delivering repair and maintenance services. Whereas in the shipbuilding industry contracts are largely won on the basis of the price quoted, the procedure of gaining contracts in the ship repair industry is more complex. Since in ship repair clients have a great interest in minimizing the time of immobilization of their vessels, three factors that play a major role in winning a contract are: the *price* quoted, the *time* it takes to perform the work needed and the *deviation costs* from last called port towards shipyard. The problem of forward planning is aggravated by the vague nature of ship repair contracts because often additional work is always discovered when the ships are actually in the docks[19], that owners will not always welcome because it means more off hire time and more expenses

The random and highly unpredictable nature of demand in ship repair industry accounts in great deal for low visibility of order book and problems in strategic forward planning. In the light of the considerable short-term fluctuations in demand, it is of crucial importance for ship repair companies to ensure a high degree of adaptability in terms of securing skilled workforce needed to perform a particular job.

Increased near term demand can be seen but it is always risky to try to put numbers on the possible increase in ship repair demand in the years ahead. The repairs market has been bolstered a bit by repairs to single-hull tanker tonnage in order to continue trading through to their phase out date or completely being transformed into a double hull tanker and trade without restrictions, now that the phase out has arrived to its final phase (2010) and when these vessels are finally due to be scrapped, this demand will fall away (Figure 2-6).

**Figure 2-6 Single Hull Tankers Phase-out**




*Source: Clarkson Research Services*

By this time the average age of the tanker fleet will also be lower. However, the volume of repair needed on 1990s built double-hull vessels is expected to take the relay. Extensive internal spaces, like double hulls and bottoms, are susceptible to corrosion and will need increased inspection.

Experts can only agree that onward increase in demand will come from the rapidly growing container fleet, as age increases. In this scenario it is expected that low cost facilities in China, European Baltic, East Mediterranean and Black Sea will maintain their competitive pressure on the higher cost yards.

In the light of global raising concerns over factors contributing to the greenhouse gases effect, as well as the environmental impact of industrial production on the planet, the shipping industry now needs to comply with an array of regulations at international, national and regional level. Attending a repair yard will give the impression of potential polluted and dangerous work area. However, yards are now more focused on environmental issues, both out of necessity to comply with regulations as well as for the sake of good reputation as a marketing purpose. Many repair techniques improvements introduced are

environmentally related. For example traditional shot blasting techniques are steadily being replaced by ultra-high pressure water blasting systems. More environment friendly, free coating systems are also being employed.

The green challenge will be a growing one as emissions from the shipping industry are estimated to leap up with the increasing global fleet. Moreover, the low public profile granted until now to the global shipping is fading out, politicians and environmental organizations are far putting more stress on industry's players to curb emissions and pollutants. Looking to the future one of the biggest challenges facing yards will be a growing shortage of skilled labor. Many yards are finding it hard to secure qualified work force from their own countries like in Northern Europe yards that have to draw in recruits from eastern Europe and Turkey, whereby return, respective yards are facing an exodus of their best workers to higher paid alternatives overseas.

## 2.6 World Competition Situation

The immediate outlook for the world's ship repair is currently unclear. What's good news is that with the tougher international regulations, class and PSC inspections that are here to keep ships up to the standards dictated by international conventions inevitably means spending more money in the ship repairs. The one drawback is whether the supposed strength will be reflected at the sharp end of the industry-*the ship repair yard*. Most yards in most regions are facing fierce competition. Long history established ship yards in Northern Europe are hit hard not only by the Far East yards in China, but also from fellow Eastern European yards. Other Singapore yards who succeeded to retain their place as the world's leading ship repair centre until the 2000's , are recently struggling with China main land cheaper repair yards taking overall the general repairs market with steel work prices down to bellow US$ 1.00/kg compared with over US$ 2.00 in Singapore. Strikingly cheaper in China is yet available, where smaller yards eager to win international business are down as far as 65 cents!, this has resulted in Singaporean yards often reluctance to tender for simple steel work when a mainland Chinese yard has already quoted!

For the owner/manager, the ship repair industry remains in a situation of over capacity, albeit much less now compared with recent years. This will always result in there being a fairly significant difference between repair quotes, sometimes as much as 50%, dependent upon workloads in the various yards.

Within every ship repair area there are "cheaper" areas: In northern Europe these areas include Poland, the Baltic States (Estonia, Lithuania and Latvia), and Russia. In the Mediterranean/Southern European area there are Turkey and the Balkan States. And in the Far East there is mainland China

If we set the ships repair cost on a scale of 100 (with Singapore as a bench mark), costs are estimated to be as per following table in different ship repairs yards in the world.

**Table 2.12 Ship Repair Costs (Steel work/ Singapore as Benchmark)**

| | | | |
|---|---|---|---|
| **Singapore** | **100** | **Mediterranean** | **125/130** |
| **Korea** | **105/110** | **Balkans/Turkey** | **110/115** |
| **China** | **50/65** | **North-Europe** | **140/150** |
| **Indonesia** | **60/75** | **Scandinavia** | **150/160** |
| **Japan** | **250** | **Baltic/Russia** | **110/115** |
| **Middle-East** | **125/130** | **USA** | **170/180** |
| **South-Africa** | **110/135** | | |

*Source: International Ship Repair- Finding the Bargain without Deviation-Alan Thorpe, 2000.*

Currently and without doubt, China is the cheapest area where to repair worldwide. Thus, increasingly the larger scale vessel repair projects, involving significant steel renewals on bulk carriers, tankers and containerships are being carried out at yards in China, where labor cost are relatively lower allowing cheaper quotations.

On another side there has been a tremendous amount of investment in new drydocks and repair berths in China recently, which has increased capacity, and this pattern is set to continue.

That said, shipyards in Singapore, Dubai and Bahrain continue to have a significant market share, within the tanker and LNG carrier markets especially. Yards in these locations are also carrying out a significant volume of work on dredgers and offshore support vessels.

Following the impact of cheaper prices and skilled workforce shortage, a new trend has been making its way into the repair industry during the last decade. The latest trend has seen many larger yards look to take over smaller or less successful yards in order to cover other trading routes and offer a more international service.


# Chapter 3 Overview of Busan Area Ship Repair Industry

## 3.1 Analysis on Status Of Korea Ship Repair Industry

Korea is worldwide well-known for being the world's shipbuilding center but the Korean ship repair industry is not of the same world class standard as the new building one.

Especially since 2005 when Hyundai Mipo Dockyard switched to the new building activity taking advantage of the strong freight market and increasing world order book. Hyundai Mipo Dockyard was the world's largest repair facility even so it had only 5% of the world market. The Mipo site's capacity included four dry-docks each capable of handling up to 400,000 dwt and 380-metre long ships supported by up to 80-ton jib cranes and three kilometers of quay repair docks which are supported by up to 30-ton jib cranes. The site is in the inner port of Ulsan and was superbly positioned for the Far-Eastern shipping trade. Mipo dockyard has processed more than 4,000 ships since the company's inception in 1975[20].

Up to 2006, yards dealing in ship repair industry across Korea are said to be about 67 yards , among these are only 9 which could be considered of medium size (Table 3-1), allowing vessels up to 170 M long, we can cite here the examples of : YS Heavy Industries , Orient Ship Yard , Mokpo Shipbuilding , Dong-Il Ship Yard , Gangnam Corporation, and Daepyung Shipbuidling…etc.

**Table 3-1 Korea Ship Repair Yards Status (up to 2006)**

| Yard Size Scale | 2004 | 2005 | 2006 |
|---|---|---|---|
| **Medium/ Major** | 9 | 9 | 9 |
| **Small** | 64 | 58 | 58 |
| **Total** | 73 | 67 | 67 |

*Source: The Korea Shipbuilder's Association*

From the above table we can see that the number of companies in ship repair industry is shrinking year-on-year and this is due to the fact that many of them are switching to newbuilding taking advantage of the high freight rate market.

## 3.2 Analysis on the International Competitiveness of Korea's Ship Repair Industry

Choosing a shipyard for dry-docking is a complicated decision for shipowners since there

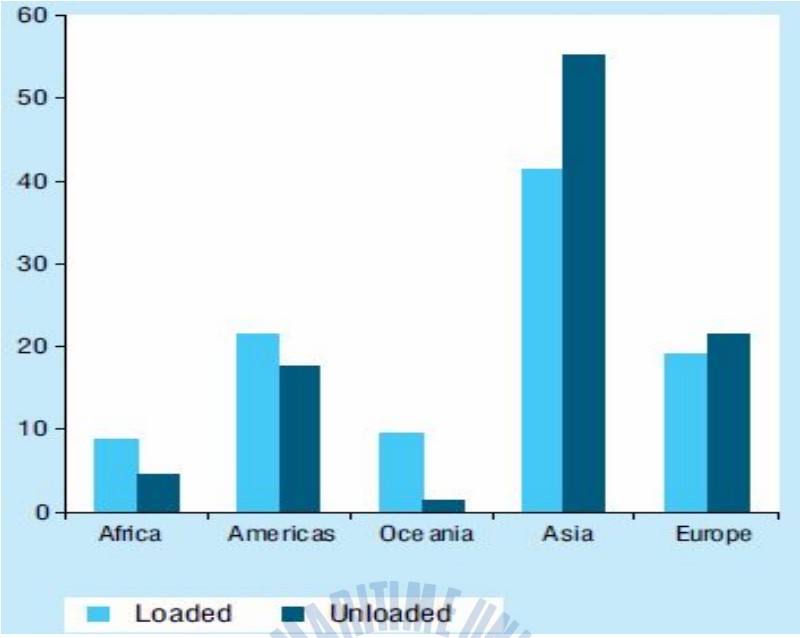
are so many factors to assess; beside the price which, greatly governs the choice, still are other elements to take in consideration depending on what kind of work is scheduled on board. Factors like the location of the yard, the capability of the yard to deliver work as required and in time. Yard location is not only considered to incur the least deviation from the last port called to the ship yard, but also to put the vessel in the best position after repairs done to get freight and resume earning the soonest. Combining the bargained price, best location with the lesser possible deviation from the vessels main trading route seems to be an impossible equation to resolve but ship yards have to offer not only the best price and delivery time for repairs but also the optimized solution for the owners regarding the immobilization of their vessels considered as an off-hire time.

### 3.2.1 Yard Location

Korea is situated in the North East Asian region, probably the busiest world trade lanes with neighboring China, Japan and Singapore just to cite these as examples. Thus we can say that Korean ports and their respective yards are strategically located and are having a potential of attractiveness to handle ship repairs in consideration of being not far from main trading routes between East and West.

From figure 3-1 We can clearly see the amount of handled sea borne trade as the Asian region taking over all other regions in the world.

**Figure 3-1 World Seaborne Trade by Regions 2009 (Percentage in Tonnage)**




*Source: UNCTAD Maritime Transport Review, 2010.*

Statistics from the Korean Ministry of Land, Transport and Maritime Affairs confirm a rise in the container traffic in 2010 compared to 2009 by 18.3 % year-on year as the real economy recovers.

**Table 3-2 Monthly Container Volume (month-on-month) in Korea Ports 2010**

(unit : 1000 TEU, %)

| section | '10.1 | '10.2 | '10.3 | '10.4 | '10.5 | '10.6 | '10.7 | '10.8 | '10.9 | '10.10 | '10.11 | '10.12 | 누계 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| total | 1,472 | 1,367 | 1,614 | 1,648 | 1,716 | 1,665 | 1,671 | 1,662 | 1,529 | 1,616 | 1,651 | 1,718 | 19,329 |
| (increase) | (25.6) | (26.5) | (21.6) | (22.4) | (28.7) | (23.8) | (20.2) | (19.6) | (7.1) | (9.0) | (10.3) | (10.8) | (18.3) |
| im/ex | 911 | 852 | 1,024 | 1,043 | 1,088 | 1,062 | 1,061 | 1,053 | 979 | 1,063 | 1,068 | 1,130 | 12,333 |
| (increase) | (31.1) | (24.2) | (21.8) | (23.2) | (26.3) | (22.1) | (17.7) | (18.9) | (7.0) | (13.8) | (13.2) | (14.0) | (18.9) |
| transship | 525 | 489 | 562 | 574 | 600 | 576 | 579 | 582 | 523 | 520 | 542 | 547 | 6,619 |
| (increase) | (14.8) | (28.9) | (19.0) | (19.0) | (31.5) | (26.1) | (23.8) | (19.5) | (6.6) | (△0.8) | (3.9) | (4.6) | (15.7) |
| coastal | 37 | 26 | 28 | 30 | 28 | 27 | 31 | 27 | 27 | 33 | 41 | 41 | 376 |
| (increase) | (85.5) | (75.1) | (96.1) | (80.8) | (76.9) | (48.2) | (50.8) | (55.8) | (20.4) | (37.2) | (27.3) | (11.4) | (48.5) |

*Source: Korea's Ministry of Land, Transport and Maritime Affairs, Press Release online( Accessed February 2011)*

An Extensive investment in ship Repair yards in Korea can be fairly supported by the fact

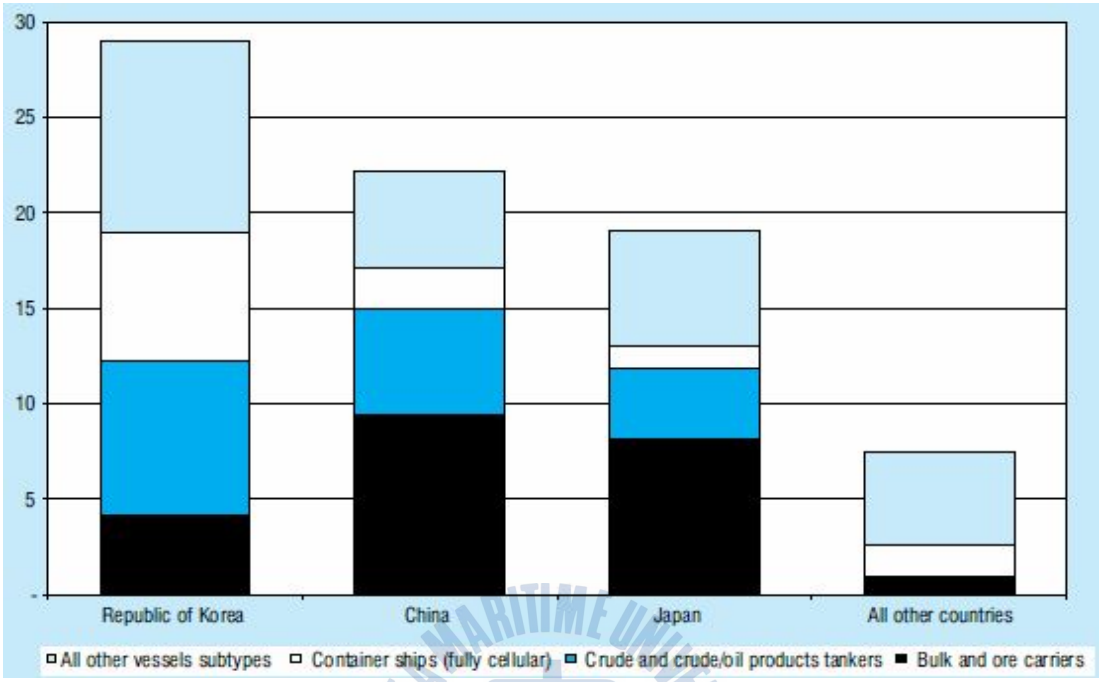
that Korean ports are enjoying a strategic position in the Northeast Asia markets in terms of trading routes passing by and the amount of cargo handled around, offering best solutions for repairs and reactivation of vessels after works done.

### 3.2.2 Repairs Technical Level

Korea's total output for shipbuilding is now number one in the world. Special attention is given here to newbuilding of specialized vessels which require high expertise in repairs that low cost ship yards didn't acquire again. According to the *UNCTAD Maritime Transport Review* 2010 More than 90% of world shipbuilding orderbook, in terms of gross tonnage, construction took place in just three Asian countries, namely the Republic of Korea (37.3 %), China (28.6 %) and Japan (24.6 %). All remaining countries together accounted for only 9.6 % of global shipbuilding in 2009 (Fig3-2).As of 1st of February 2011 the world orderbook stood at 7,191 ships of 463.7millions DWT (MDWT). China had an order book of 3,061 ships of 191 MDWT, while Korea's and Japan's are 1,538 ships of 251.4 MDWT and 1,096 ships of 80.4 MDWT respectively. However, Korea's orderbook is worth a total of $136.5bn, against china which is $120.3bn. Japan comes in third with $56.5bn[21].

Always according to UNCTAD, more than 57% of container ship tonnage and 73% of gas carriers are built in the Republic of Korea. Here is the point, where we see high-value upturning to the Korean shipbuilders' expertise in specialized vessels recognized globally. Gas look ripe for investment with the LNG-carrier backlog shrinking and only now representing 7% of the operating fleet (Table.3-3).

**Figure 3-2 Newbuilding Vessels Deliveries in the Main Shipbuilding Countries.2009 (in 1000s of GRT)**




*Source: UNCTAD Maritime Transport Review 2010*

It has been reported in the shipping specialized newspaper Tradewinds in its hard copy of February 23rd 2011, due to this tiny orderbook, the lowest in 10 years, big names of the LNG are lining up new orders. Middle East giant producer Qatar gas which controls a fleet of 54 LNG carriers is said to be making enquiries for up to six new vessels.

Golar LNG appears to have secured four slots at Samsung Heavy Industries at prices below $200m. Other move from Norway's Hoegh LNG says it has signed Letter of Intent at Hyundai Heavy Industries for two 170,000-cbm FSRUs (Floating Storage & Re-gasification Units) with four options. This is good news for shipbuilding but also for ship repair with midterm scheduled repair demand to be foreseen for strengthening. Thus LNG ship repair business can be claimed as a growing one due to the expanding fleet.

**Table 3-3 World LNG Order Book 2011.**

**Samsung Heavy Industries: 14 ships**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| Angola LNG | 4 | 160,000 | Aug 2011 – Jan 2012 |
| Chevron | 4 | 160,000 | 2013 onwards |
| GasLog | 2 | 155,000 | 2013-2014 |
| Flex LNG | 4 | 220,000 | open |

**Daewoo Shipbuilding & Marine Engineering Co: 7 ships**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| TMT | 2 | 171,800 | awaiting instruction* |
| Sonangol | 3 | 160,500 | Oct - Dec 2011 |
| Brunei Gas Carriers | 2 | 147,000 | Jan/Jul 2011 |

**Mitsubishi Heavy Industries: 1 ship**

| | | | |
|---|---|---|---|
| NYK | 1 | 145,400 | 2014 |

**Kawasaki Heavy Industries: 2 ships**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| Tokyo Gas/NYK | 1 | 177,000 | 2011 |
| NYK | 1 | 177,000 | 2012 |

**Hudong-Zhonghua Shipbuilding (Group): 5 ships**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| Shanghai LNG | 1 | 147,000 | 2012 |
| MOL | 4 | 170,000 | 2015-2016** |

**Dingheng Jiangsu: 2 ships**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| Teekay | 2 | 12,000 | 2011 |

**Taizhou Zhongyuan: 1 ship**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| IM Skaugen | 1 | 10,000 | 2011 |

**Meyer Werft: 1 ship**

| Owner | no. | cbm | delivery |
|---|---|---|---|
| Anthony Veder | 1 | 15,600 | end 2012 |

**Total: 33 ships (plus two conversions)**

*The "Crystalsky" and "Clearsky" have been completed and are awaiting sale or charter
**Contract to be formally signed in the next few months

*Source: LNG Business Report of Tradewinds.Tradewinds.no, 2011*

## 3.2.3 Repairs Cost

Regarding price it is clear that not only in Korea, but also world's traditional ship repair yards situated in developing countries have already lost their competitive advantage to lower cost ship repair centers due to high repair costs in a labor intensive industry such as the ships repair, an inherent feature that will give naturally an advantage to available cheap labor developing countries.

The un-competitiveness of the ship repair sector, by virtue of the higher cost involved for

ship repair projects, compared with foreign shipyards specifically those from China, is essentially the result of labor cost. It is assumed that labor cost constitutes 50 % of the repair cost , and according to United States department of labor, hourly compensation cost in 2006 (published in 2008), among Asian countries , Korea's hourly compensation is US$16.87 , almost 20% more expensive than Singapore but 40% cheaper than Japan (Table 3-4).

**Table 3-4 Hourly Compensation Cost in 2006**

| Area | Country | Production Workers | | All Employees | |
|---|---|---|---|---|---|
| | | US$ | Korea=100 | US$ | Korea=100 |
| Asia | Japan | 20.2 | 137.2 | 24.40 | 144.6 |
| | Korea | 14.72 | 100.0 | 16.87 | 100.0 |
| | Singapore | 8.55 | 58.1 | 13.55 | 80.3 |
| Europe | Germany | 34.21 | 232.4 | 41.04 | 243.3 |
| | Italy | 25.07 | 170.3 | 28.71 | 170.2 |
| | Norway | 41.05 | 278.9 | 46.31 | 274.5 |
| | Poland | 4.99 | 33.9 | 6.26 | 37.1 |
| | Portugal | 7.65 | 52.0 | 9.54 | 56.6 |
| | Spain | 18.83 | 127.9 | 22.05 | 130.7 |
| | U.K | 27.10 | 184.1 | 33.71 | 199.8 |
| America | U.S.A | 23.82 | 161.8 | 29.6 | 175.5 |

*Source: Journal of Navigation and Port Research Vo.34.No.10,pp799-805, 2010*

Further analysis of costs related to ship repairs in Korea with comparison to China and Singapore (Tables 3-5 & 3-6) even gives the impression that Korean prices could be cheaper compared to direct competitors in China and Singapore. However, a corollary weakness nullifying this assumed competitive advantage of Korea's yards is the fact that there are only a few limited capacity local shipyards that can cater for dry-docking/ repair of small ships. Such a situation limits the capacity and capability of Korea's ship repair sector to respond to emerging opportunities and demands, unless more local shipyards are

able to expand and upgrade their current level of operations.

**Table 3-5 Korea, China, and Singapore Repair Yards Services Charges Comparison (Unit: US $)**

| Repairs Category | | Country | | |
|---|---|---|---|---|
| **Item** | **Repairs work** | **Korea** | **China** | **Singapore** |
| **General Service** | Wharfage/day (~2,000 GRT) | 272 | 125 | 313 |
| | Mooring/time (~5,000 GRT) | 763 | 400 | 800 |
| | Mooring/time (5,000~20,000 GRT) | 1,400 | 605 | 1,560 |
| **Dockage** | 500~5,000 GRT (First 2 days) | 4,900 | 1,850 | 5,500 |
| | ~20,000 GRT ( First 2 days) | 12,700 | 4,673 | 15,400 |
| | ~50,000 GRT (First 2 days) | 25,400 | 13,430 | 36,400 |
| **Hull part** | Steel work/ton (20ton) | 60,000 | 50,000 | 128,000 |
| | Paint work/m² (Deck, Full one coat) | 0.48 | 0.30 | 0.60 |
| | Tank Cleaning/m² (Fuel oil Tank ~100 m²) | 13.33 | 12.00 | 19.00 |
| **Engine Work** | Piston Cylinder (Bore 600 mm ) | 790 | 630 | 985 |
| | Propeller (Shaft 400 mm) | 320 | 270 | 415 |
| | Rudder Lift & Refit (~10,000 GRT) | 2,883 | 2,306 | 3,750 |
| **Other work** | Shore Power/Kwh | 0.20 | 0.17 | 0.44 |
| | Sea Chest 300 mm | 120 | 100 | 130 |
| | Crane Charge (~30 ton/hour) | 90 | 75 | 200 |

*Source : A Study on FHP to Improve the Competitiveness of Ship Repair Industry in Busan" Doctoral Degree Thesis by Sung-Tae Kim Busan National University 2009*

**Table 3-6 Korea, Singapore, China Repairs Costs Comparison (Unit US$)**

| Vessel type | GRT | Repairs period | Item | Country | | |
|---|---|---|---|---|---|---|
| | | | | Korea | China | Singapore |
| General cargo | 5,000 | 2008.06 | Wharfage | 2,610 | 1,300 | 2,852 |
| | | | Dockage | 9,310 | 3,700 | 11,000 |
| | | | Hull work | 101,660 | 52,500 | 131,000 |
| | | | Engine work | 248,140 | 197,100 | 267,000 |
| | | | Electric work | 108,260 | 70,000 | 135,000 |
| | | | Total | **469,980** | **324,600** | **546,852** |
| Container | 10,000 | 2008.08 | Wharfage | 1,520 | 1,050 | 2,230 |
| | | | Dockage | 16,510 | 6,230 | 20,020 |
| | | | Hull work | 159,460 | 112,000 | 170,000 |
| | | | Engine work | 87,170 | 68,000 | 109,600 |
| | | | Total | **264,660** | **187,280** | **301,850** |
| Chemical Tanker | 5,000 | 2008.08 | Wharfage | 2,342 | 1,175 | 2,540 |
| | | | Dockage | 6,370 | 2,466 | 7,333 |
| | | | Hull work | 75,140 | 63,000 | 74,000 |
| | | | Engine work | 118,990 | 85,300 | 135,200 |
| | | | Total | **202,842** | **151,941** | **219,073** |
| Fishing vessel | 300 | 2008.05 | Wharfage | 1,978 | 925 | 1,613 |
| | | | Dockage | 8,166 | 3,083 | 9,166 |
| | | | Hull work | 35,070 | 30,600 | 40,540 |
| | | | Engine work | 81,960 | 62,000 | 87,050 |
| | | | Electric work | 6,460 | 5,000 | 7,300 |
| | | | Total | **133,634** | **101,608** | **145,669** |
| Oil Tanker | 10,000 | 2008.06 | Wharfage | 1,520 | 1,050 | 2,230 |
| | | | Dockage | 12,700 | 4,670 | 15,400 |
| | | | Hull work | 9,690 | 9,100 | 11,900 |
| | | | Engine work | 75,970 | 60,500 | 77,500 |
| | | | Electric work | 970 | 910 | 1,500 |
| | | | Total | **100,850** | **76,230** | **108,530** |

*Source : A Study on FHP to Improve the Competitiveness of Ship Repair Industry in Busan" Doctoral Degree Thesis by Sung-Tae Kim Busan National University 2009*

## 3.3 Analysis on Operation of Busan Ship Repair Industry

In terms of container traffic, Busan port is proudly considered as ranking the 5th Busiest port in the World. The Busan's area ship repair facilities as considered on a local scale, has 25 ship repairs dedicated yards and 391 workshops dealing with ship repairs and servicing as shown in the following table :

**Table 3-7 Busan Region Share in Korean Ship Repair Related Business**

**( Number of Companies)**

| Category | Repair Yards | Repair Workshops | Total |
|---|---|---|---|
| **Korea** | 12 | 995 | 1,124 |
| **Busan** | 25 | 391 | 416 |
| **Busan Region Share** | 19.4% | 39.3% | 37.0% |

*Source: "Busan Region Ship Repair Industry Status and Development Plan" The Bank of Korea-Busan Branch 2003*

Busan is then representing almost 20% of ships repair capabilities in Korea and almost 40% as of the businesses dealing with ship repairs and servicing. The present facilities in Busan are considered of a small scale since the maximum vessel to be accommodated can't go beyond 10,000 DWT.

**Table 3-8 Busan Region Ship Repair Companies Size**

| Category | Total | Medium | Small |
|---|---|---|---|
| **Number of Companies** | 33 | 9 | 24 |
| **Average Labor (Workers)** | 22 | 46 | 13 |
| **Average Capital (100 Millions KRW)** | 12. | 29.9 | 6.1 |
| **Average Sales (100 Millions KRW)** | 29.8 | 78.1 | 11.7 |

*Source:,"Busan Region Ship Repair Industry Status and Development Plan" The Bank of Korea-Busan Branch 2003*
*Note: Medium Scale > 3Billion KRW Sales, Small Scale <3 Billions KRW sales*

## 3.4 Busan Area Main Ship Repair Yards

### 1) Gang-Nam Corporation

Established in 1969 as Hyundai Composite Company. Was appointed as a company of national defense Industry in 1975 and then started to build large and small high size of patrol crafts. In 1976, company name was changed to GangNam Corporation.

- Has a New construction division engaged in FRP vessel made such as MSH (Mine Sweeping Hunter), MHC (Mine Hunting Craft), High speed patrol boat and Rescue/Life boat etc…

- Ship repairing division has capability of performing repair and conversion up to 150 vessels per year.

### 2) Orient Ship Yard

Established as "Orient Marine Services Co., Ltd." In 1987. Changed name to Marine Engineering Co., ltd. in 1995 and then started ship repair and conversion services. In 2001 renamed as Orient Shipyard co., ltd. Expanded in ship repair business since 2006 by purchasing a 35,000 MT class floating dock and has a branch in Gwangyang. Orient shipyard since 2008. Has successfully acquired an agreement for boat repair for Military Sealift Command and U.S. Navy vessels in Korea since 2010.

Orient Shipyard has two floating docs dedicated for ship repair :

-15,000 ton (210 m) floating dock (Busan Yard)

-65,000 ton (300 m) floating dock ( Gwangyang Yard)

### 3) Donghae Shipbuidling Co., Ltd.

Established in 1988, engaged in shipbuilding mainly for barges, tugboats and other floating docks, and also ship repairs for vessels not exceeding 7,000 GRT. It has two main slipways of 180 M.

### 4) Dong-Il Ship Yard Co., Ltd.

Dong- il Ship yard was established as "Dongil Marine Engineering Co., Ltd." In 1970

March 23rd. Renamed as "Dongil Shipyard Co.,Ltd." In 2004 December 28th. Merged and Acquired Namsung Shipyard Co.,Ltd. since n 2010 January 1st. Dong- il shipyard has a full controlled subsidiary in Vietnam Called the" Dongil Vungtau Shipyard Co.,Ltd". Since 2005.Dongil shipyard is engaged in new building, conversion and repairs and ship spare parts manufacturing (rescue boat davit, line hauler, piston, cylinder head, cylinder liner…etc).

The Main facilities and equipments are:

**Dongil Busan shipyard**:

Slipway No.1 up to 2,000 tons

Slipway No.2 up to 5,000 tons

Slipway No.3 up to 3,500 tons

Slipway No.4 up to 3,500 tons

02 Tower cranes of 5 tons each

**Dongil Vungtau shipyard (Vietnam)**

Dry dock up to 5,000 DWT vessels

Slipway up to 300 tons

01 quay of 110 meters can receive up to 8,000 DWT vessels.

**5) Samhwa Shipbuilding, Co**

Established as "Dong-A Shipbuilding, Co" in 1942. Renamed as Samhwa Shipbuilding, Co. on 1963 May 20th. Engaged in fishing boats and general cargo vessels' repairs.

The main facilities are as follows:

Slipway No.1 up to 2,500 tons

Slipway No.2 up to 1,200 tons

Slipway No.3 up to 2,500 tons

**6) Dongbang Ship Machinery Co., Ltd.**

Dongbang Ship Machinery Co., Ltd. Was founded in 1994 specializing in designing and manufacturing Pipe spool and Module units for vessels, owns a repair facility in Kamchon-Dong with a slipway which can accommodate vessels up to 12,500 tons.

**7) Daepyung Shipbuilding Co., Ltd.**

Engaged in shipr epairs with the Following main facilities :

Slipway No.1 up to 5,000 tons

Slipway No.2 up to 6,000 tons

Slipway No.3 up to 3,000 tons ( Situated in Yeongdo)

**8) Sunjin Shipbuilding Co., Ltd.**

Established in 1951 as Busan Shipbuilding & Engineering Co., LTD with two sets of slipways 7,500 DWT and 6,500 DWT capacity; was taken over in 2001 by the Sunjing Shipbuidling Co., LTD. Engaged mainly in ship repairs and conversion works.

## 3.5 SWOT Analysis of Busan'S Ship Repair Industry

Despite the foregoing potential roles of the ship repair sector, there are weaknesses and threats which currently nullify its strengths and opportunities serving to deter the realization of its latent potentials. Foremost and critically pivotal is the inability of the Busan's ship repair sector to effectively compete with neighboring foreign shipyards (i.e. Singapore, China, etc.) in catering to both national and international demands/ requirements for ship repair projects. In order to provide a framework and basis on what areas need to be addressed in, the sector's *Strengths, Weaknesses, Opportunities* and *Threats* were identified as presented hereunder.

### 3.5.1 Strengths

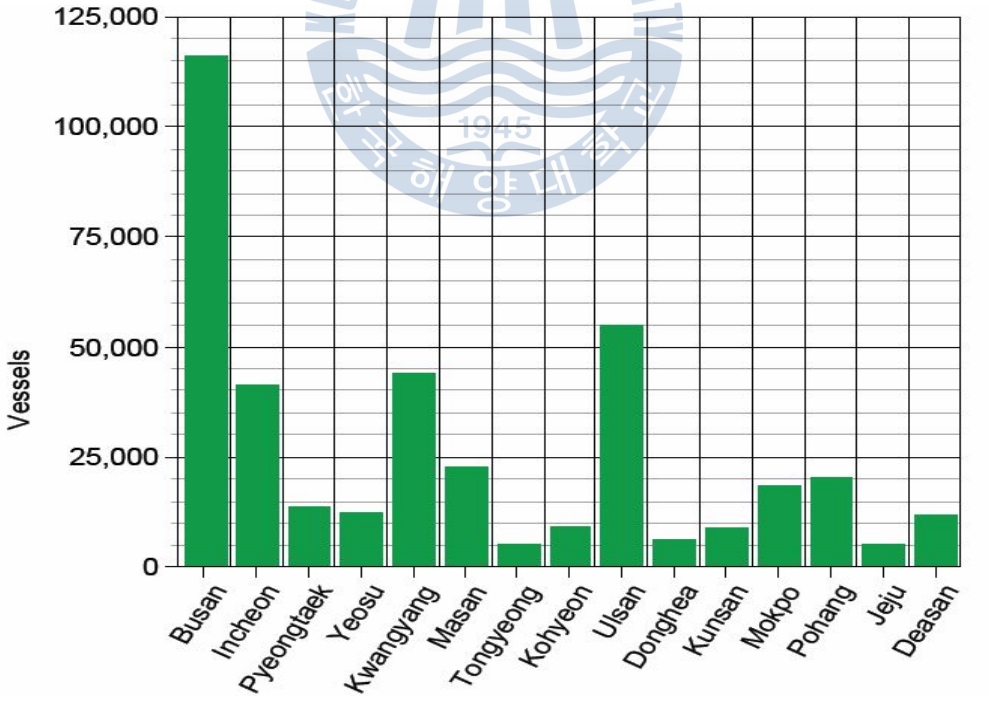
A latent strength of the sector which still needs to be fully exploited is the Busan's strategic location to the shipping routes of oceangoing ships serving the Asia-Pacific region and which made it ranking the World's 5$^{th}$ busiest port (Table 3-9) and the first destination for national and international freight (Figure 3-3). Such strategic location could be translated into the area becoming a hub for ship repair and dry-docking of oceangoing ships, including fishing vessels operating in international waters.

**Table 3-9 World's Top 10 Busiest Ports**

| World ranking | | | | Port name | Country | Trade region | Total TEU in 2009 |
|---|---|---|---|---|---|---|---|
| 2009 | 2008 | 2007 | 2006 | | | | |
| 1 | 1 | 1 | 1 | Singapore | Singapore | South–East Asia | 25 866 400 |
| 2 | 2 | 2 | 3 | Shanghai | China | East Asia | 25 002 000 |
| 3 | 3 | 3 | 2 | Hong Kong | Hong Kong, China | East Asia | 20 983 000 |
| 4 | 4 | 4 | 4 | Shenzhen | China | East Asia | 18 250 100 |
| 5 | 5 | 5 | 5 | Busan | Republic of Korea | East Asia | 11 954 861 |
| 6 | 8 | 12 | 15 | Guangzhou | China | East Asia | 11 190 000 |
| 7 | 6 | 7 | 8 | Dubai | United Arab Emirates | West Asia | 11 124 082 |
| 8 | 7 | 11 | 13 | Ningbo | China | East Asia | 10 502 800 |
| 9 | 10 | 10 | 11 | Qingdao | China | East Asia | 10 260 000 |
| 10 | 9 | 6 | 7 | Rotterdam | Netherlands | Europe | 9 743 290 |

*Source: UNCTAD Transport Review2010..*

**Figure 3-3 Korea Selected Ports' Vessels Traffic 2008**




*Note: Data Source: Ministry of Land, Transport & Maritime Affairs on Line (Accessed February 2011).*

A more concrete strength of the ships repair sector in Busan is the readily locally available technical and skilled manpower for shipbuilding and ship repair works. Many workers have

inherent skills for shipyard-related jobs like welding, pipe fitting, molding, etc., including technical/engineering competence. With comprehensive training programs, a pool of skilled shipyard manpower would easily become a valuable basic asset of the sector. Moreover, the labor cost in Busan area is cheaper than other main Korean regions dealing with shipbuilding and ship repairs (Table 3-10).

**Table 3-10 Comparison of Regional Labor Cost in Korea Main Yards Regions (Busan as Benchmark )**

| City | Busan | Ulsan | Geogae | Mokpo | Gwanyang |
|---|---|---|---|---|---|
| **Labor cost** | 100 | 120 | 120 | 125 | 110 |

*Source: Orientshipyard.com (Accessed February 2011)*

Busan has also a big advantage of enjoying the presence of Korea's shipbuilding majors with their respective subcontractors engaged in constructions of almost all kinds of vessels, this has yielded a strong long time built-in experience in shipbuilding and who can be better to service your vessel than its original maker! Busan with its plenty of workshops for reconditioning, repairs and servicing for vessels and vessels parts has a latent leading position in ship repairs.

These strengths can be seen largely in favor of Busan ship repair industry therefore for the time being and compared to other Korean ship yards, Busan yards seem to have the lead and are more competitive on almost all levels (Table 3-11).

**Table 3-11 Korea South West Region Vs Busan Ship Repair Competitiveness Comparison**

| Category | | Busan Region | Korea | South West Region |
|---|---|---|---|---|
| | | | Mokpo/ Shinan | Koheung./ Kwangyang |
| Yard Related FActors | Location | 5 | 3 | 3 |
| | Repairs Cost | 4 | 5 | 5 |
| | Repairs Technical Level | 5 | 4 | 3 |
| Industry Related Factors | Equipment and Consumable supply | 5 | 4 | 3 |
| | Crew Facilities | 5 | 4 | 3 |
| Facilities | Development factors | 2 | 3 | 5 |
| Total | | 26 | 23 | 22 |

*Source: Competitiveness Analysis of Ship Repair Industry in Jeonnam. Master Degree Thesis by Seo-Mu Cheon. Mokpo National University, 2010-*

## 3.5.2 Weaknesses

A major weakness that needs to be addressed urgently , serving as a major obstacle to the sector's development in order to make it globally competitive and responsive to emerging challenges, is the prevailing situation wherein severe shortage of ship repair facilities in Busan area ship yards with very limited docking capacity accommodating small vessels only.

Also cost, efficiency, is not yet competitive compared with shipyards in neighboring countries. This is basically the reason why there are only limited ship repair projects undertaken in local shipyards, with those undertaken confined mostly to small ships. It is also the same reason why shipyards in Busan are unable to fully attract oceangoing ships despite the strategic location of the Busan port area.

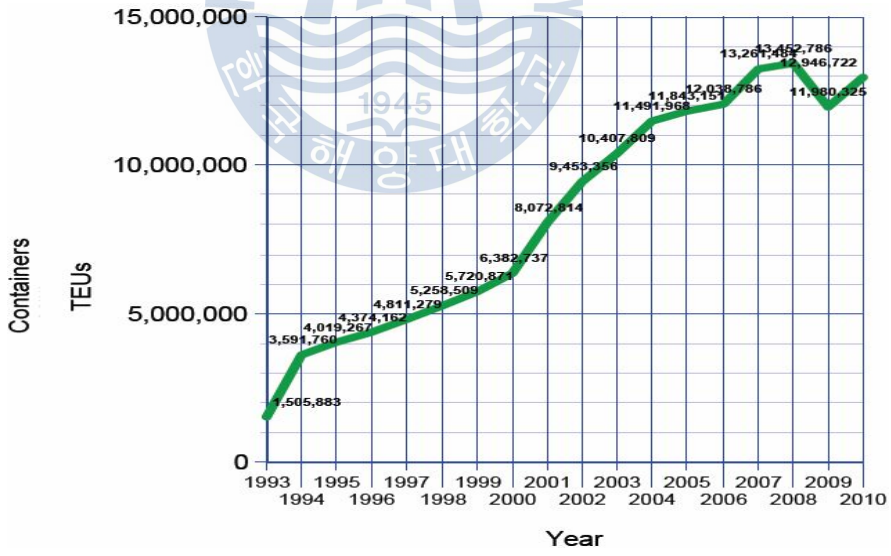
Moreover, the basic requirements for ship repair projects, on an expanded basis, such as steel plates and equipment/parts from ancillary industries are almost imported or locally available with uncompetitive prices. Importing such requirements, although is not exempted from import duties and diminishes efficiency of shipyard operations [22], considering the time lag entailed for such requirements to become available, thereby

increasing cost and time spent to complete attendant projects. Reducing both import duties and granting vessels coming to Busan for repairs exemption from port dues will help stimulate the industry and would also foster the growth of ancillary industries in order to maximize the economic multiplier effects of increased ship repair projects in the area.

## 3.5.3 Opportunities

Busan is strategically located in the North East Asia region on the East-west trading route, actually the busiest trading one as already discussed above. This shows the huge existing potential of traffic in the area. Only considering container vessels , and according to the *Ministry of Land, Transport and maritime Affairs*, cargo volume at Busan port was 14.8 million TEU in 2010, which is 18.4% higher than 2009. With increased coastal shipping services such as Busan-Pohang, etc., Pusan port handles 73.6% of total container volume which is 0.3% increase compared to 2009 and it is expected that container traffic will reach 20 million TEU in 2011.

**Figure 3-4 Busan Port Containers Throughput 1993-2010**




*Note: Data source from Busan Port Authority on Line, (Accessed March 2011).*

## 3.5.4 Threats

To be urgently addressed are the following identified main threats. First is the rapid development of ship repair facilities in neighboring countries especially in china and Singapore confirming their position as established destinations for global ship repair

industry. Substantial investments both local and foreign originated in China helped to build, in a very short time, a large scale repair capacity able to manage big size vessels. China is considered now as the cheapest place where to repair for steel replacement work.

In Singapore, major ship repair yards though facing increasing competition from China and Middle east yards, continue to reinforce their position as leaders in specialized vessels' repairs and conversion jobs. Other neighbors to Korea in the North east Asian region are seriously working on developing their ship repairs capacities such as Vietnam. No surprise then for the resulting preference for cheaper and more specialized yards in neighboring countries by both domestic and foreign shipowners/operators, lowering demand for the local ship repair industry. Some big Korean owners are even having their own repair facilities developed in neighboring countries such as China and Vietnam where abundant cheap labor and local governments' encouragement for foreign investors in order to enhance their attractiveness as an alternative repairs source. This is just adding more strength to the competitiveness of yards in the neighboring countries in detriment of local yards. Last and not least is that we can't see any kind of claimed Vision from the Korean Government for the ship repair industry same as for the country's shipping and shipbuilding industries depriving the local yards from a valuable support that could strengthen their competitiveness while facing a fierce competition from neighboring countries' ship repair yards benefiting from their respective governments from substantial support and subsidies. Ship repair industry is labor intensive one and could stimulate local employment and regional development if integrated in a national development vision by the government.

# Chapter 4 AHP Methodology

## 4.1 Purpose of the Survey Study

The study at hand has been designed to figure out best ways to raise the competitiveness of Busan's ship repair industry in the Northeast Asian markets. Since the competitiveness of an industry is influenced by several elements so for the good sake of this study, AHP (Analytic Hierarchy Process) is used to analyze the results of the survey that will be handed over to stakeholders in ship repair industry in Busan area.
The AHP has been chosen for the advantage that it allows to compare several elements and factors influencing the problem at hand, compare them each one to another and help prioritizing the relative importance of various criteria when determining the best option for a defined problem.

## 4.2 Introducing the Analytic Hierarchy Process

The AHP is a structured technique for dealing with complex decisions. Rather than prescribing a "correct" decision, the AHP helps decision makers find one that best suits their goal and their understanding of the problem—it is a process of organizing decisions that people are already dealing with, but trying to do in their heads.

Based on mathematics and psychology, the AHP was developed by Thomas L. Saaty in the 1970s and has been extensively studied and refined since then. It provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions.

It has particular application in group decision making, and is used around the world in a wide variety of decision situations, in fields such as government, business, industry, healthcare, and education.

Users of the AHP first decompose their decision problem into a hierarchy of more easily comprehended sub-problems, each of which can be analyzed independently. The elements of the hierarchy can relate to any aspect of the decision problem—tangible or intangible,

carefully measured or roughly estimated, well- or poorly-understood—anything at all that applies to the decision at hand.

Once the hierarchy is built, the decision makers systematically evaluate its various elements by comparing them to one another two at a time, with respect to their impact on an element above them in the hierarchy. In making the comparisons, the decision makers can use concrete data about the elements, or they can use their judgments about the elements' relative meaning and importance. It is the essence of the AHP that human judgments, and not just the underlying information, can be used in performing the evaluations.

The AHP (software) helps to convert these evaluations to numerical values that can be processed and compared over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy, allowing diverse and often incommensurable elements to be compared to one another in a rational and consistent way. This capability distinguishes the AHP from other decision making techniques.

In the final step of the process, numerical priorities are calculated for each of the decision alternatives. These numbers represent the alternatives' relative ability to achieve the decision goal, so they allow a straightforward consideration of the various courses of action.

### 4.2.1 Scale of Intensity of Importance

AHP Procedure is very similar to hierarchical value structure, and in the model, there are 1-9 scales of the intensity of importance which will be used like ruler for measuring each

factor. The scales are showing as the following table.

**Table 4-1: 1-9 Fundamental Scale of Importance Degree in AHP Methodology**

| THE FUNDAMENTAL SCALE OF PAIRWAISE COMAPRISONS | | |
|---|---|---|
| **Intensity Of importance** | **Definition** | **Explanation** |
| **1** | Equal importance | Two elements contribute equally to the objective |
| **3** | Moderate importance | Experience and judgment slightly favor one element over another. |
| **5** | Strong importance | Experience and judgment strongly favor one element over another. |
| **7** | Very strong importance | One element is very strongly favored over another; its dominance is demonstrated in practice. |
| **9** | Extreme importance | The evidence favoring one element over another is of the highest possible order of affirmation. |
| Intensities of 2, 4, 6, 8, can be used to express intermediate values. intensities 1.1, 1.2, 1.3…etc can be used for elements that are very close in importance | | |

*Source: Wikipedia.org*

## 4.3 SWOT Matrix for Busan Area Ship Repair Industry

According to the SWOT analysis of BUSAN Area ship repair industry the SWOT matrix is

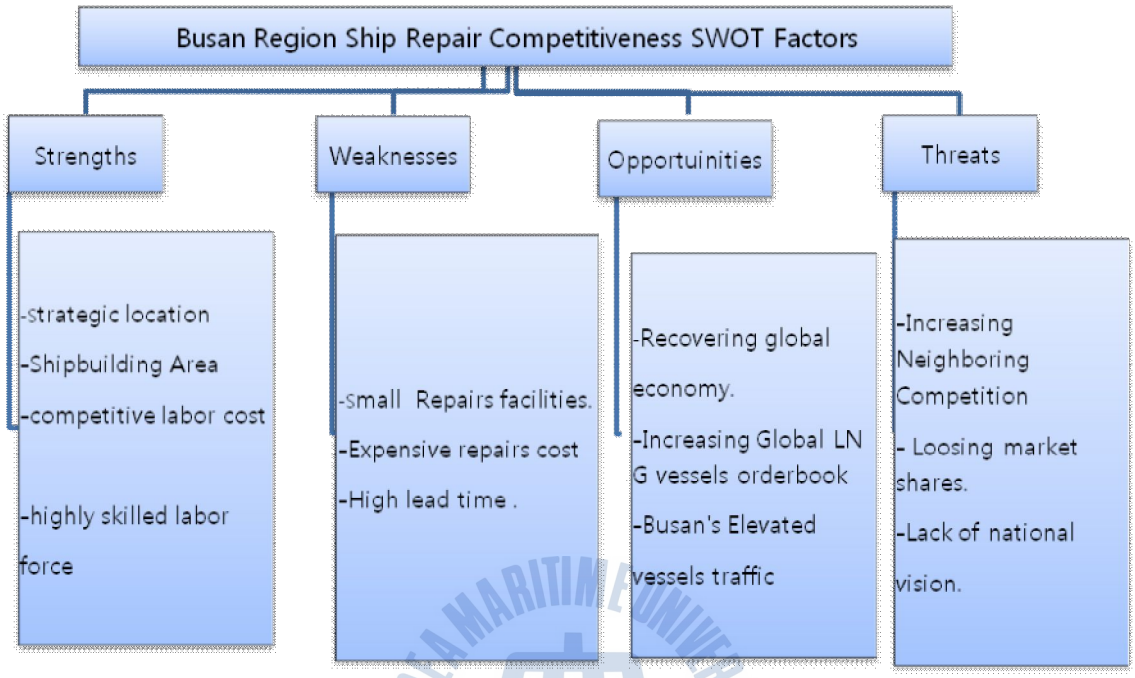
as the following table.

**Table 4-2 SWOT Matrix for Busan Area's Ship Repair Industry**.

| [Strengths] | [Weaknesses] |
|---|---|
| −Strategic location in the Northeast Asia region.<br><br>−Presence of Korea major shipbuilders and port related industry<br>−competitive labor cost compared to other Korean regions.<br>−Availability of highly skilled labor force. | − Scarcity of existing repair capacity limited to small vessels.<br><br>− Expensive repairs cost compared to competitors (i.e. China, Singapore).<br><br>−High lead time for repairs undertaking. |
| [Opportunities] | [Threats] |
| −Recovering global economy hence vessels traffic.<br><br>−Increasing global order book for high technology LNG vessels being built mainly in Korea.<br><br>−Busan port elevated vessels traffic compared to other Korean ports. | −Increasing neighboring competition with larger Repair capacity especially in China and Singapore.<br>− Loosing market shares with Preference of both national and foreign shipowners for more competitive neighboring repair yards.<br><br>−Lack of national vision for ship repair industry. |

The questionnaire object of the survey study was made up from the above SWOT matrix as the following scheme:

**Figure 4.1 Hierarchical Structure for Busan Ship Repair Industry Competitiveness.**




## 4.4 Details of Respondents to the Questionnaire

The study employed the geometric average method, which re-generalizes the survey after evaluation. The main reason for employing the geometric average method is due to the fact that this method is the lonely procedure that satisfies the characteristic of a reciprocal number of the pairwise comparison. Hence, all comprehensive opinions were gathered, and calculated the weight value via applying each matrix value of the pairwise comparison matrix on the 1,3,5,7 and 9.

The survey respondents were chosen among stakeholders in ship repairs industry in Busan area, replying to three main categories: ship repair yards, shipping and ship management companies and marine engineering and repairs providers companies, this last category includes marine engineering companies, ships' spare parts suppliers and recondition services workshops.

The survey was designed to use the pairwise comparison evaluation used for calculating the

significance of AHP analysis.

A total of 48 participants were invited to answer the questionnaire object of the survey study, among them nine (09) foreign companies from Japan, Russia, and Thailand, all familiar with Busan port with vessels calling regularly Busan port and also in Chinese ports and other Russian and Singapore ports. All Japanese and Thai companies are both managers for gas and chemical tankers while the Russian companies are managers of fishing vessels.

All the respondents to the questionnaire were prepared to use the pairwaise comparison method and to bear in mind while answering, the Busan port area and its direct competitors in China and Singapore.

Except for the foreign respondents to the questionnaire from whom the answers were collected by email all the other respondents in Busan area were approached by direct visits to their premises in Busan.

Finally a total of 48 answers to the questionnaire were collected from April 15$^{th}$ 2011 until 17$^{th}$ may 2011.

After applying the AHP program to the collected answers, among them 20 copies showed a Consistency Ratio > 0.15 which were eliminated from the sample selection, the remaining 28 copies with a consistency ration ≤0.15 were used for the combined results of the survey. The details of the retained respondents are as the following table:

**Table 4-3 Details of Respondents to the Questionnaire**

| | Distinction | Number | Ratio |
|---|---|---|---|
| Nationality | Korean | 24 | 85.7% |
| | Foreign | 4 | 14.3% |
| Business category | Ship repair Yard | 8 | 29% |
| | Shipping company | 13 | 46% |
| | Marine engineering & repairs workshops | 7 | 25% |
| Work Department | | | |
| Shipyard (8 ) | Director office | 3 | 37.5% |
| | Work management Dept | 5 | 62.5% |
| Shipping company (13) | Director Office | 6 | 46% |
| | Fleet maintenance & repairs Dept | 5 | 38% |
| | Operation Dept | 2 | 16% |
| Marine engineering & repairs workshops (7) | Director Office | 1 | 14% |
| | Technical Dept | 4 | 57% |
| | Other | 2 | 29% |
| Work Position | Director | 10 | 36% |
| | Manger | 13 | 46% |
| | Ass. Manager | 5 | 18% |
| Total 28 (100%) | | | |

*Source: Analysis of Survey Results.*

## 4.5 Results of the AHP Analysis

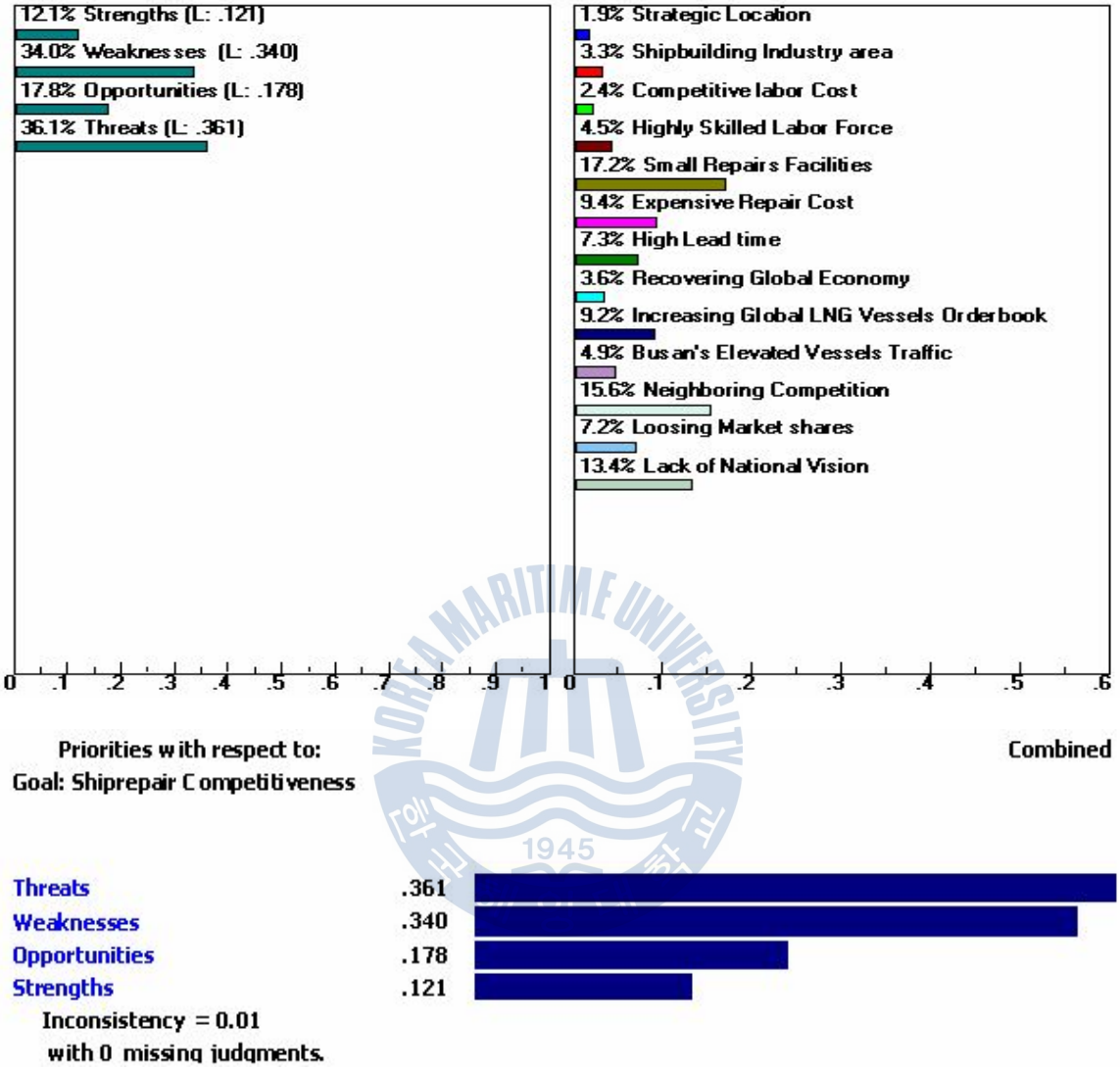
### 4.5.1 Main Matrix Factors Importance Degree Results

To get to the goal of raising the competitiveness of the ship repair industry in Busan area, a SWOT matrix was established on the basis of which a questionnaire has been handed over to respondents with interests in the ship repair industry. The results of the survey for the four elements of the SWOT matrix are as the Figures 4-2 showing the importance degree of each factor in the decision making.

First factor that should be considered is the threats one with significance of 36.1% to the decision making, followed by the weaknesses factor with a very close significance of 34%.

The Opportunities factor is weighing 17.8% significance while the Strengths factor comes last with 12.1% significance. The threats and weaknesses factors together weighted more than 70% of importance to decision making, even though there are some strengths and opportunities for Ship repair industry in Busan but their importance is relatively insignificant underlying the very weak current status of the ship repair industry in Busan region.

**Figure 4-2 Intensity of Importance Degree of the SWOT Matrix Factors**

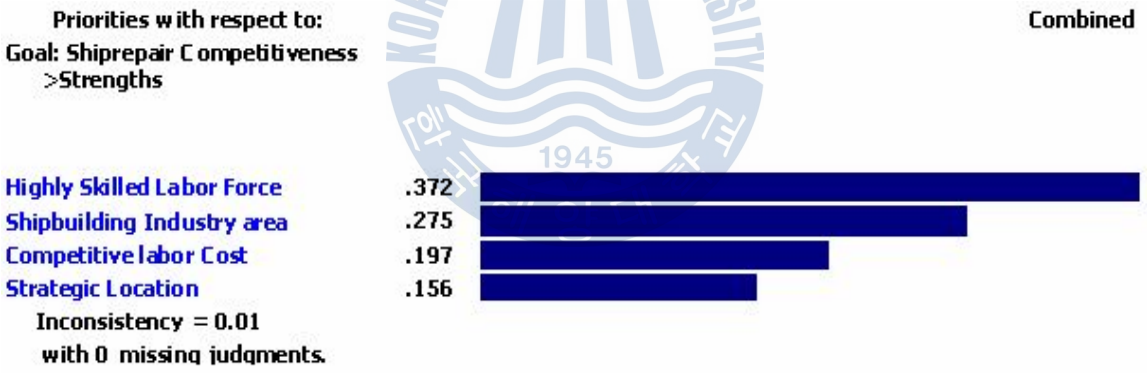



## 4.5.2 Intensity of Importance for the Specific Factors of the SWOT Matrix

## 1) The Strength Factors

As shown in the figure 4-3 below the most significant elements among Strength factors is the locally available highly qualified workforce with the biggest intensity of (0.372) followed by the factor that Busan area enjoys the presence of the majors of shipbuilding in the country and related ship servicing and repairs providers companies with a significance of (0.275). Remaining factor of the competitive labor cost compared to other Korean regions with a significance of (0.197) and came last with a significance of (0.156). It is important to mention here that almost all the respondents didn't agree about the labor cost in Busan to be more competitive than other regions.

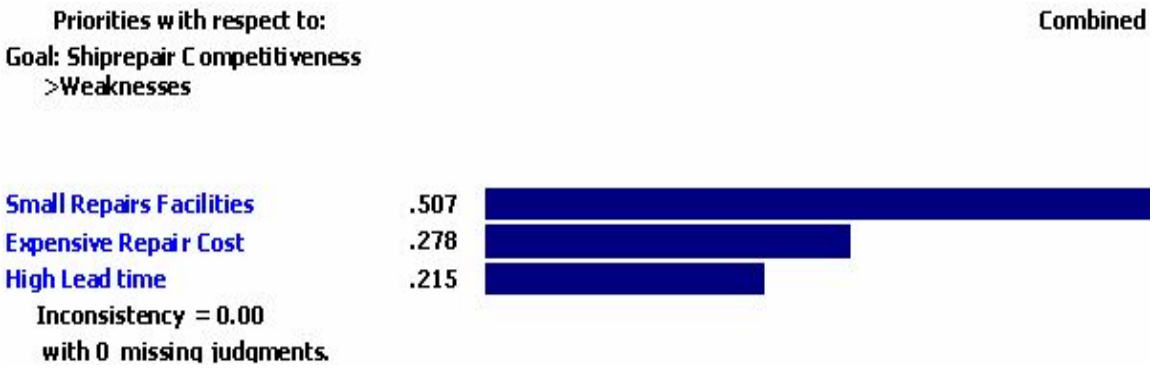
**Figure 4-3 Intensity of Importance Degree of the Strength Factors**




## 2) The Weaknesses Factors

The figure 4-4 below shows clearly that the main weakness factor of Busan ship repair industry is the limited dockage capacity to small vessels only with a significance of (0.507) which is of 50 % of importance to the decision making. The remaining factors of the higher repairs cost compared to China and Singapore and the high repairs lead time are represented by (0.278) and (0.215) of significance respectively.

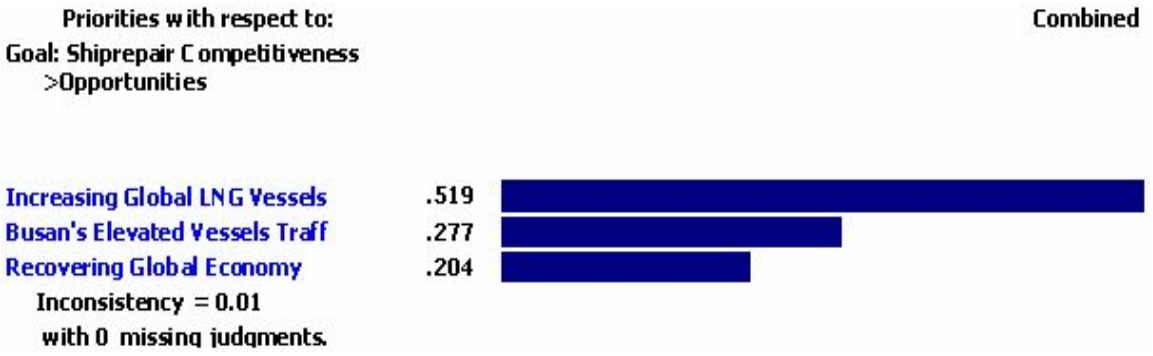
**Figure 4-4 Intensity of Importance Degree of the Weaknesses Factors**




## 3) The Opportunities Factors

The Opportunity that weighted the absolute highest intensity of (0.519) among Opportunities factors is clearly the LNG vessels growing orders hence a specialized repair industry for LNG vessels that could back the newbuilding one given the current new dynamics of the LNG shipping and the valuable experience of Korean shipbuilding industry for specialized vessels and the servicing industry that will benefit by consequence. The other chosen opportunities factors of the recovering global economy and the elevated vessels traffic in Busan port weighted (0.204) and (0.277) respectively.

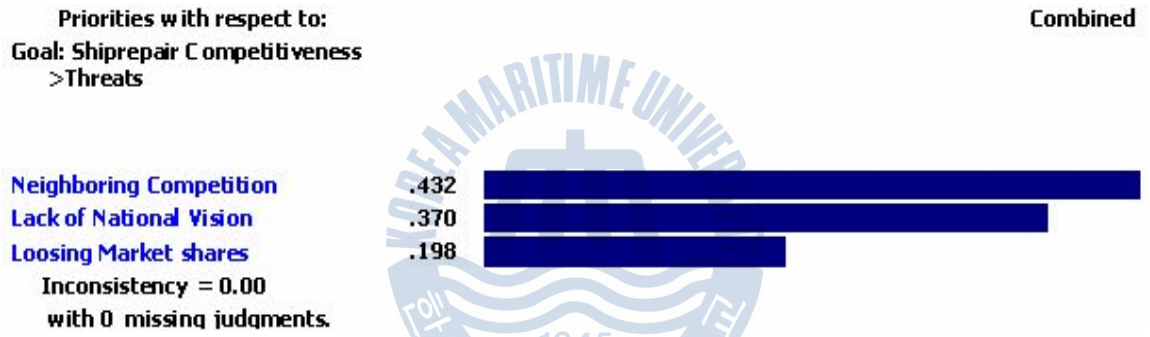
**Figure 4-5 Intensity of Importance of the Opportunities Factors**




## 4) The Threats Factors

The data analysis for the threats factors shows clearly that the main threat to the Busan's ship repair industry is the factor of rapid development of ship repair industry in the neighboring countries mainly in China and Singapore, this factor weighted an intensity of (0.432), followed by the factor of the lack of a national vision to support the ship repair industry in Korea. The third factor of the preference of shipowners for the neighboring countries' repair yards weighted only (0.198) probably because this factor is a direct consequence of the other factors of a lack of national vision and the loosing of market shares by direct competitors in the Northeast Asian area.

**Figure 4-6 Intensity of Importance of the Threats Factors**



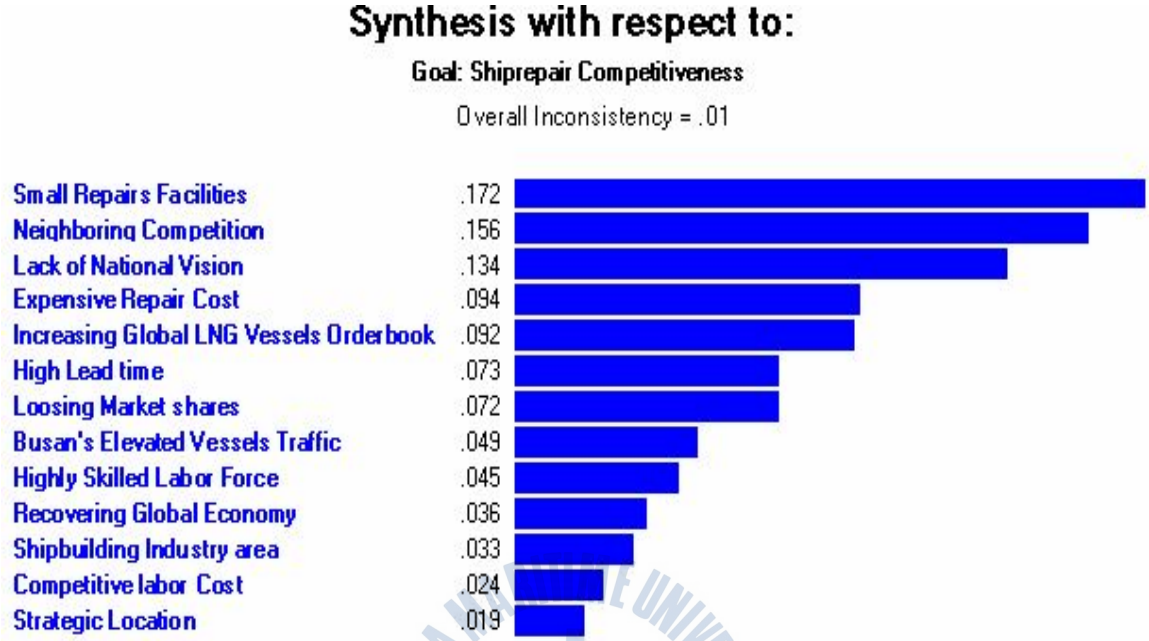

## 4.5.3 Synthesis of Intensity Importance of all the SWOT Matrix Factors

The Figure 4-7 below illustrates a synthesis of intensity importance of all the factors of the SWOT matrix of the Busan's area Ship repair industry.

The top ranking factors as seen from the figure 4-7 are: first the Limited dockage capacity with a significance of 0.172, followed by the factor of the rapid development of ship repair industry in neighboring countries mainly in China and Singapore and in the third position came the factor of the lack of national vision to support the industry.

The above mentioned factors belong to the weaknesses and Threats factors respectively urging the necessity to be fixed as a condition to any plan to raise the competitiveness of Busan ship repair industry. The remaining factors weighted more or less.

**Figure 4-7 Synthesis of Intensity Importance of all the SWOT Matrix Factors**




# Chapter 5 Conclusion

## 5-1 Conclusion

The ship repair industry is as global as shipbuilding and shipping industries with regional centers all over the world competing for the unlimited diverse requirements of the world fleet and its trading patterns. It is a highly competitive and volatile as other shipping markets and, like them has been badly influenced by the Global financial crisis since 2008. Originally, the world centre for ship repair industry was known to North-west European yards which first lost their competitiveness to Far East players especially Singapore and China and later to their own fellow Eastern Europe yards which have seen growth with their national economies getting more liberalized and investing much in shipbuilding and ship repair taking advantage of the cheap labor cost same as the Chinese yards. Globally, the Chinese and Eastern Europe yards area currently considered as the cheapest places where to repair. For the specialized vessels repairs such as Tankers and LNG vessels repairs market, a fierce competitive battle is between the Middle East and Singapore.

The Middle East yards succeeded to gradually taking into the established market shares of Singapore yards by extensive investments in new facilities especially in Dubai and Bahrein. With the Middle East, China is probably the main area where Ship repair industry knows the fastest growth taking over almost all the global general repairs market shares with very cheap steel work prices.

New players are making their entrance gradually to the shipbuilding and ship repairs markets with ambitious development plans like India and Vietnam. All over the world are other repair facilities which tend to be focusing on local markets and trading routes.

The Korean ship repair industry though in a World leader shipbuilding country is not enjoying the same world class status and is presenting deep structural and physical weaknesses compared to its direct competitors in the region.

This research study was initially designed to figure out how to raise the competitiveness of Korean ship repair industry and especially Busan's area using the Analytic Hierarchy Process (AHP) analysis methodology for the results of the questionnaire that had been handed over to the ship repair industry stakeholders in the area on the basis of a SWOT

analysis.

## 5-2 Recommendations

From the AHP data analysis it comes out clearly that the Busan's area ship repair industry is unfortunately in a very weak status compared to its direct competitors in the Northeast Asian markets, with the factor of limited docking facilities capacity as the main factor of the SWOT matrix to weigh most intense significance degree of importance to the decision making with respect to raising competitiveness of the industry. We cannot talk about any other competitiveness factors such as the repairs cost and technical level, or take full advantage of the opportunities that Busan area enjoys with such a serious scarcity in repairs facilities.

The main issue that came out from this research survey's data analysis regarding repairs facilities comes to converge with previous research studies about ship repair industry in the area of Busan where the same weakness has been already diagnosed.

The first solution then should be dealing with the repairs capacity by unconditionally upgrading the existing facilities to accommodate bigger vessels. The current facilities in Busan area are, speculatively, at their best allow dry-docking of 10,000 DWT vessels or even less.

In a study by Myung-sin Ha for "*a Scheme of High Value-added Strategy of Port Related Industries in Busan*" published in the Korea International Commerce Review (Vol.20 No.1 2005/03) on a sample of 75 companies customers of Busan port, revealed at a rate of 90% of the respondents are for developing a complex for ship repairs in Busan area, the same respondents designated at a rate of 21.3% as a disadvantage of Busan port the lack of adequate repair facilities and at a rate of 24% the need to exempt the vessels coming to Busan for repairs from paying port dues. This figures show the importance of ship repair industry in adding to the competitiveness of Busan port. The fierce competition in the Northeast Asia region between ports imposes to Busan port to sharpen its competitiveness by taking full advantage of its strengths and opportunities; Busan port is ranking among the top 10 world busiest ports thus giving an assurance for investors in ship repair of market

shares and by return attracting more shipowners to call Busan port for its giving the right facilities without deviation from their trading routes. Beyond the awareness of the local operators for the need of a strong repair industry in the area of Busan there are other encouraging factors for investing the sector. The main demand stream for ship repairs comes from the physical need to keep vessels seaworthy and fulfill regulations and chartering requirements.

Demand can be seen for increasing in the short and medium terms, supported by the expected return of old tonnage to trading a trend that will be strengthened by recovering freight markets on the medium term. The Bangladesh Environmental Lawyers Association (BELA) successfully halted the country's ship breaking industry which counts for almost one-quarter of global breaking market with 175 recycled vessels of 2.19 million LDT (Light Deadweight Tons) in 2009, before being stopped by judgment of The Bangladeshi High Court for not less than 11 months until April 2011. Following this situation so many vessels even though secured for breaking are said to be receiving offers for further trading, vessels as old as 1977 built[23].

This means, that old tonnage may be given a chance before being due to scrap, since owners may find some difficulties to secure good cash prices from breakers who may see their operation cost raised due to pressures for a more environment-friendly breaking industry. Ageing vessels are then again potential clients of repair yards.

With reference to the AHP data analysis in this study, the strengthening trend for LNG vessels newbuildings that weighted the highest significance among other opportunities factors, focus here is on the specialized vessels' repairs, where the yards are chosen for their know-how and not necessarily for the cheapest price given the high technical level of maintenance and repairs. Whilst the main issue for repairs on LNG carrier is the containment systems; the industry is still debating what level of deformation is acceptable for a containment system. It all means business for the world specialist LNG ship repairers. In the Far East, Singapore's *Keppel* and *Sembawang Yards* are the two main facilities slugging it out with *Malaysia Marine & Heavy Engineering* for the work[24].

[23] "Bangladesh braces for a long retart" Tradewinds.no 2011.
[24] "LNG, Tradewinds Business Report." Tradewinds.no 2011

Knowing the fact that the global LNG fleet is young and mostly South Korean built, this will give immediately a Korean LNG specialized ship repair one step ahead. Meanwhile due to the current tight market and lack of tonnage, the oldies of LNG carriers are seeing more trading opportunities but not after upgrading along with their running repairs.

Equally, the LPG-carrier orderbook has decreased, representing only 9% of the fleet, a factor that could encourage investment in the nearest future. All these are signs that specialized vessels repairs will much more be needed in the coming short and long terms than ever before.

The other factor of competitiveness that comes third in significance after the AHP data analysis is the lack of national vision in Korea for the ship repair industry hence a lack of government support to local players should they be repairers or owners. This issue is regarded as of high importance to an industry such as the ship repairs one.

Necessarily, efforts to enhance the competitiveness of the sector in relation to competing foreign shipyards will inevitably involve measures to address the other identified weaknesses and threats of the sector. It would therefore be essential to undertake action plans and programs that further enhance efficiency and economy of shipyard operations, thereby reducing costs. Singapore has already been hiring cheap labor from neighboring countries to enhance its competitiveness in ship repairs against Chinese shipyards.

Ship repair industry as a labor intensive one can be a strong stimulator for local employment. The interrelation existing between ship repair industries and other shipbuilding and shipping industries will foster for a strong basis for Busan city as a hub in the Northeast Asia region with its comprehensive services offered to the maritime community.

Things are already moving around Busan in the neighboring countries. China has stated policy aiming to become the world's largest shipbuilding and ship repair nation as earlier as 2015; Vietnam has set the objective of becoming the fourth larger producer by 2015. The Indian government is fully involved in upgrading the shipbuilding and ship repair through its *Shipbuilding and Ship Repair Industry Eleventh Five Year Plan (2007-2012*)

This requires from the Korean Government to deploy more efforts in accompanying the

local ship repairers in a national vision to develop the industry as soon as possible.

Such efforts would at the same time address the other threats of the sector, which is the more competitive option of ship repairs provided by neighboring countries like China, and Singapore. The alternative to be provided by Busan's shipyards will need to capitalize both on cost and quality compared with its direct competitors in the Northeast Asian markets.

At last, it is worthy to mention here that this study had been limited in the research that it should have gone through by the lack of necessary time for a thorough research and to the lack of up-to- date data about the ship repair industry in Busan, the data used is back to 2003 from a study realized by the Bank Of Korea about Busan area's ship repair industry.

## 5-3 Further Research

It came out from the literature review in this research the small amount of studies that focused on ship repair industry in Korea or in Busan region, it is required than that more comprehensive and thorough studies be developed about this strategic sector.

Future studies should be concerned first of all with the current situation of ship repair industry in Korea in terms of collecting up-to-date data about the repairs facilities on business since so many would have been switching to newbuilding. Than a comprehensive research should study more deeply the ship repair industry in its whole features such as the social one about the workforce employment, operational and financial aspects. Only a more detailed research can help to forge a national vision about the ship repair industry and stand to decide the best ways to fix the physical and structural weaknesses diagnosed.

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# Appenix 1

# 설문지

**< A STUDY ON THE COMPETITIVENESS OF SHIP REPAIR INDUSTRY IN BUSAN AREA USING AHP >**

안녕하십니까? 귀사의 무궁한 발전을 기원합니다.
한국해양대학교 해운경영학과 석사과정 아메우르입니다

본 설문지는 부산지역 수리리조선산업 경쟁력을 강화하는 방안을 마련하기 위한 연구의 일환으로 수행되는 것입니다.

각 평가항목 간 상대적 중요도를 전문가의 관점에서 판단하여 주시면 감사하겠습니다. 응답의 일관성이 낮은 경우 배제되오니, 귀중한 설문이 의미있게 활용될 수 있도록 응답해 주시면 감사하겠습니다.

본 설문의 결과는 오직 연구목적으로만 사용될 것이며, 각 개인의 응답으로 어떠한 불이익도 생겨나지 않도록 하겠습니다.

2011. 04.

지도교수 류 동 근
석사사과정 아메우르

E-mail: ameur_kr@live.fr
(문의처 : 010-8362-1636)

➢응답 요령

1. 질문의 순서대로 모든 문항에 빠짐없이 응답하여 주시기 바랍니다. 질문 내용이 귀하의 상황에 적합하지 않거나 상황에 꼭 맞는 응답번호가 없는 경우에는 가장 가깝다고 생각되는 상황에 맞추어 응답해 주시기 바랍니다.

<중요성 척도>

| 중요성 정도 | 정의 |
|---|---|
| 1<br>3<br>5<br>7<br>9 | 같다<br>약간 중요하다<br>중요하다<br>극히 중요하다<br>절대적으로 중요하다 |
| | 2, 4, 6, 8 은 인접한 중요도에서 중간점수<br>(각각 중간 정도의 중요도를 추정) |

본 설문지에서는 2 가지 평가기준을 1 대 1 로 쌍대비교하게 됩니다.

| "강점" 대 "약점" 의 비교 | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 기준 | 중료<——————————————동일——————————————>중료 | | | | | | | | | | | | | | | | 기준 |
| | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | |
| 강점 | | | | | | | | | | | | | | | | | 약점 |
| | >>강점이 약점보다 5만큼 더 중료 | | | | | | | | | | | | | | | | |

2. 응답 일관도

AHP 분석에서는 분석의 부산물로 비 일관도 지수가 생성됩니다. 비 일관도 지수가 **0.15 이상이 될 경우 응답결과를 신뢰할 수 없다고 판단되어 재설문**하게 됩니다. 비 일관도 지수가 높게 나오는 데는 크게 다음과 같이 두 경우가 해당됩니다.

예) 1. A > B : A 가 B 보다 2 배 중요하다고 응답
2. A ≫ C: A 가 C 보다 4 배 중요하다고 응답
→ B > C 라고 응답해야 함

[원인 1] 기수적 일관성 결여 : A > B > C

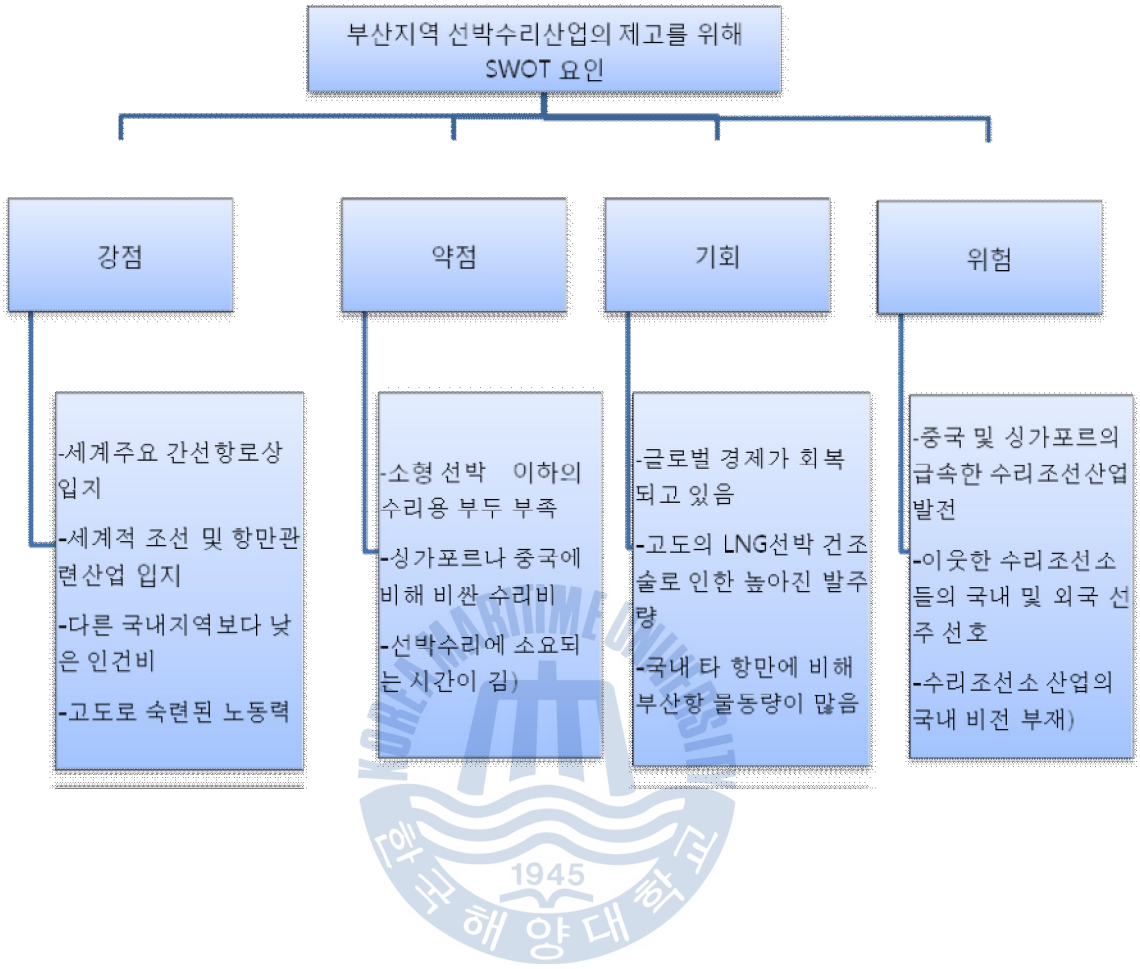
[원인 2] 기수적 일관성 결여 : 위 예에서 B 가 C 보다 9 배 중요하다고 응답할 경우

## ◈ 응답자 일반사항

| | |
|---|---|
| Company name/ location<br>Department | |
| Position | |

※ 다음은 본 연구자가 작성한 부산지역 선박수리산업 경쟁력 SWOT Matrix 입니다.

| 강점 [Strengths] | 약점 [Weaknesses] |
|---|---|
| -strategic location in the Northeast Asia region(세계주요 간선항로상 입지).<br>- Presence of Korea's Major Shipbuilders and Port related industry(세계적 조선 및 항만관련산업 입지).<br>-competitive labor cost compared to other Korean regions (다른 국내지역보다 낮은 인건비).<br>-Availability of highly skilled labor force (고도로 숙련된 노동력). | - Scarcity of existing repair capacity limited to small vessels (소형선박 이하의 수리용 부두 부족).<br>- Expensive repairs cost compared to competitors (i.e. China, Singapore)(싱가포르나 중국에 비해 비싼 수리비).<br>-High lead time for repairs undertaking(선박수리에 소요되는 시간이 김). |
| 기회 (Opportunities) | 위협 [Threats] |
| -Recovering global economy hence vessels traffic (글로벌 경제가 회복 되고 있음).<br>-Increasing global order book for high technology LNG vessels being built mainly in Korea (고도의 LNG 선박 건조술로 인한 높아진 발주량).<br>-Busan Port Elevated vessels traffic compared to other Korean ports (국내 타 항만에 비해 부산항 물동량이 많음). | -Increasing neighboring competition with larger Repair capacity especially in China and Singapore (중국 및 싱가포르의 급속한 수리조선산업 발전).<br>-Loosing market shares with preference of both national and foreigner shipowners for more competitive neighboring repair yards (이웃한 수리조선소들의 국내 및 외국 선주 선호).<br>-Lack of national vision for ship repair industry(수리조선소 산업의 국내 비전 부재). |


부산지역 선박수리산업의 제고를 위해
SWOT 요인
강점
약점
기회
위험
-세계주요 간선항로상 입지
-세계적 조선 및 항만관련산업 입지
-다른 국내지역보다 낮은 인건비
-고도로 숙련된 노동력
-소형 선박 이하의 수리용 부두 부족
-싱가포르나 중국에 비해 비싼 수리비
-선박수리에 소요되는 시간이 김)
-글로벌 경제가 회복되고 있음
-고도의 LNG선박 건조술로 인한 높아진 발주량
-국내 타 항만에 비해 부산항 물동량이 많음
-중국 및 싱가포르의 급속한 수리조선산업 발전
-이웃한 수리조선소들의 국내 및 외국 선주 선호
-수리조선소 산업의 국내 비전 부재)

※ 설뭍은 평가항목들 간 상대적 중요도를 평가하기 위한 것입니다. 전문가의 관점에서 응답하여 주시면 감사하겠습니다.

| 질문 1) 부산지역 선박수리산업의 경쟁력 제고를 위해 SWOT 요인 중 어느 요인이 얼마나 더 중요하다고 생각하십니까? | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 기준 | 중요 ←------- 동일 -------→ 중요 | | | | | | | | | | | | | | | | | 기준 |
| 강점 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 약점 |
| | | | | | | | | | | | | | | | | | | |
| 강점 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 기회 |
| | | | | | | | | | | | | | | | | | | |
| 강점 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 위험 |
| | | | | | | | | | | | | | | | | | | |
| 약점 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 기회 |
| | | | | | | | | | | | | | | | | | | |
| 약점 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 위험 |
| | | | | | | | | | | | | | | | | | | |
| 기회 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 위험 |
| | | | | | | | | | | | | | | | | | | |

| 질문 2) 부산지역 선박수리산업의 경쟁력의 강점요인 중 어느 요인이 얼마나 더 강점이 있다고 생각하십니까? | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **기 준** | **중요 ←------- 동일 -------→ 중요** | | | | | | | | | | | | | | | | | **기 준** |
| 세계주요 간선항로상 입지 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 세계적 조선 및 항만관련산업 입지 |
| | | | | | | | | | | | | | | | | | | |
| 세계주요 간선항로상 입지 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 다른 국내지역보다 낮은 인건비 |
| | | | | | | | | | | | | | | | | | | |
| 세계주요 간선항로상 입지 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 고도로 숙련된 노동력 |
| | | | | | | | | | | | | | | | | | | |
| 세계적 조선 및 항만관련산업 입지 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 다른 국내지역보다 낮은 인건비 |
| | | | | | | | | | | | | | | | | | | |
| 세계적 조선 및 항만관련산업 입지 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 고도로 숙련된 노동력 |
| | | | | | | | | | | | | | | | | | | |
| 다른 한국지역보다 낮은 인건비 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 고도로 숙련된 노동력 |

| 질문 3) 부산지역 선박수리산업의 경쟁력의 약점요인 중 어느 요인이 얼마나 약점이 더 있다고 생각하십니까? | | |
|---|---|---|
| **기 준** | **중요 ←------- 동일 -------→ 중요** | **기 준** |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 소형 선박 이하의 수리용 부두 부족 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 싱가포르나 중국에 비해 비싼 수리비 |
| | | | | | | | | | | | | | | | | | | |
| 소형 선박 이하의 수리용 부두 부족 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 선박수리에 소요되는 시간이 김 |
| | | | | | | | | | | | | | | | | | | |
| 싱가포르나 중국에 비해 비싼 수리비 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 선박수리에 소요되는 시간이 김 |
| | | | | | | | | | | | | | | | | | | |

| 질문 4) 부산지역 선박수리산업 경쟁력의 기회점요인 중 어느 요인이 얼마나 더 기회가 있다고 생각하십니까? | | |
|---|---|---|
| 기 준 | 중요 ←------- 동일 -------→ 중요 | 기 준 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 글로벌 경제가 회복 되고 있음 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 고도의 LNG 선박 건조 기술로 인한 높아진 발주 량 |
| | | | | | | | | | | | | | | | | | | |
| 글로벌 경제가 회부 되고 있음 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 국내 타 항만에 비해 부산항 물동량이 많음 |
| | | | | | | | | | | | | | | | | | | |
| 고도의 LNG 선박 건조 기술로 인한 높아진 발주 량 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 국내 타 항만에 비해 부산항 물동량이 많음 |
| | | | | | | | | | | | | | | | | | | |



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| 질문 5) 부산지역 선박수리산업의 경쟁력의 위험요인 중 어느 요인이 얼마나 더 위험이 있다고 생각하십니까? | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **기 준** | **중요 ←------- 동일 -------→ 중요** | | | | | | | | | | | | | | | | | **기 준** |
| 중국 및 싱가포르의 급속한 수리조선산업 발전 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 이웃한 수리조선소들의 국내 및 외국 선주 선호 |
| | | | | | | | | | | | | | | | | | | |
| 중국 및 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 수리조선 |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 싱가포르의 급속한 수리조선산업 발전 | | | | | | | | | | | | | | | | | | 소 산업의 국내 비전 부재 |
| 이웃한 수리조선소들의 국내 및 외국 선주 선호 | ⑨ | ⑧ | ⑦ | ⑥ | ⑤ | ④ | ③ | ② | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | ⑨ | 수리조선소 산업의 국내 비전 부재 |
| | | | | | | | | | | | | | | | | | | |

# -감사합니다-