A Study of Korean Shipbuilders' Strategy for Sustainable Growth

By

Duck Hee Won

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Signature of Author_____

Duck Hee Won
MIT Sloan School of Management
May 7, 2010

Certified by_____

Scott Keating
Senior Lecturer, MIT Sloan School of Management
Thesis Supervisor

Accepted by_____

Michael A. Cusumano
Faculty Director, M.S. in Management Studies Program
MIT Sloan School of Management

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Abstract

This paper aims to develop potential strategies for Korean shipbuilders for sustainable growth by understanding the characteristics of the shipbuilding industry and the current market situation.

Before the financial meltdown in 2008, in the five preceding years, the healthy global economy and the rapid growth of the Chinese economy led to 35% compound annual growth rate (CAGR) in shipbuilding orders. Korean shipbuilders' sales and profits increased dramatically and they invested aggressively to meet the global demand. However, because of the financial crisis, the shipbuilding orders in 2009 decreased by 92% compared to 2007. Accordingly, the decrease in new orders will become a serious risk for Korean shipbuilders to manage because it will cause loss of economies of scale and cash deficit, at the same time.

Historically, it is true that the profits of Korean shipbuilders generally mirrored the volume of global seaborne trade, which is ultimately driven by global GDP growth. However, even though the world growth rate, as predicted by OECD, turns positive in 2010, the drastic shrinkage in the shipbuilding demand may not easily recover because of oversupply of fleet volume.

In this thesis, I will address current status of the shipbuilding market, project a market forecast, and analyze financial information of four major Korean shipbuilders. Considering the current market situation and financial status of Korean shipbuilders, I will suggest for Korean shipbuilders some potential business strategies as follows: focusing on offshore units, exploiting new market demand, and considering business diversification.

Thesis Supervisor: Scott Keating
Senior Lecturer, MIT Sloan School of Management

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Chapter 1 Introduction

1.1 Background

Shipbuilding has been an attractive and an important industry for countries such as Japan, Korea, and China aiding them during their development and nation building stages. These countries regarded the shipbuilding industry as a backbone industry that could generate huge positive effects on downstream and upstream industries such as shipping, steel, non-metal, electric, and machinery industries. The shipbuilding industry itself is both a capital-intensive industry that needs massive capital expenditure and a labor-intensive industry that has a huge effect on employment. Additionally, it is a major foreign currency earner that can contribute to current account balance by exporting ships. Japan, for instance, promoted the shipbuilding industry to recover its industrial infrastructure destroyed during WWII. The Korean government supported the shipbuilding industry for its economic development plan in 1970s to succeed. Recently, the Chinese government announced that China would try to achieve the leadership position in the shipbuilding industry by 2015.

From the time Hyundai Heavy Industries (HHI) successfully delivered its first order, 260,000 DWT VLCC[1] in 1974, Korea finally became a world shipbuilding leader surpassing Japan in terms of annual new orders and orders booked in 2000. Before the financial meltdown in 2008, in the five preceding years, the healthy global economy and the rapid growth of the Chinese economy led to 35% CAGR in shipbuilding orders in terms of CGT[2]. The sales and profits of Korean shipbuilders increased dramatically and they invested aggressively to meet the global demand.

[1] DWT: Dead Weight Tonnage / VLCC: Very Large Crude Carriers
[2] CGT: Compensated Gross Tonnage / Refer to Appendix 1 for detail explanation of measurements

However, because of the unexpected financial crisis in 2008, shipbuilding orders in 2009 decreased by 92% compared to 2007, and therefore an over-capacity problem came to the fore. Furthermore, in the 2000s, China increased its shipbuilding market share from 7% to 35%, and accomplished a strong presence in simpler ship types.

1.2 Objectives of the Thesis

Because of the recent environment, total collapse in demand, over capacity in supply, and threats from Chinese shipbuilders, a sense of crisis is spreading among Korean shipbuilders. How long can Korean shipbuilders show a relatively promising performance as an industry leader? How long will this market downturn last? What are their financial constraints and potential risks? What business strategy should be considered?

This paper aims to suggest potential strategies for Korean shipbuilders by considering their market position, competitive advantages, and financial constraints. To suggest potential and feasible strategies, I will analyze the world shipbuilding industry according to the industry level and market level, and specifically Korean shipbuilders, regarding their competitive advantages and financial status and risks in depth.

1.3 Methodologies

First, literature research is employed to review shipbuilding history, industry characteristics, and key factors for performance. Second, data research is implemented to analyze the current market situation and to project market forecast. Third, financial analysis of Korean shipbuilders is implemented based on annual reports and IR reports to examine their financial characteristics and to design potential business strategies.

1.4 Structure of the thesis

The thesis comprises 7 chapters. Chapter 1 begins with background, objectives of thesis, and the methodologies applied.

Chapter 2 provides a rather broad look at what we call an overview of the shipbuilding industry. This industry level analysis will discuss leadership changes during the 20th century, and also provide descriptions of main products, the shipbuilding process, major shipbuilders, and key features. The leadership changes demonstrate that a simple factor advantage such as cost leadership cannot be sustained for an extended period of time. Also, detailed explanations of main products, the shipbuilding process, and its major players will provide a general background of the shipbuilding industry. Lastly, identification of key features will give a broad understanding of the shipbuilding industry.

Chapter 3 defines major external and internal factors that affect a shipbuilder's performance. This chapter aims to answer why shipbuilders' profitability fluctuates and is different among them. Also, this analysis will be a basis for SWOT analysis in Chapter 7.

In Chapter 4, market level analysis is implemented in terms of demand, supply, and price. Based on this market analysis, I forecast market demand for the coming five years. Whether the market recession will rebound in the short term or not will provide direction to Korean shipbuilders' business strategy.

In Chapter 5, I will narrow down the topic to discuss the current position and competitive advantages of Korean shipbuilders. I will then explain Korean shipbuilders' strong presence in offshore units. This chapter will provide suggestions showing where their competitive advantages and market opportunities lies.

In Chapter 6, the financial data of four major Korean shipbuilders are analyzed based on

their annual reports. The financial analysis will shed light on feasible strategies that Korean shipbuilders can implement to sustain themselves in this market downturn, at the same time, will suggest ways in which they can pay attention to potential financial risks.

In Chapter 7, I will implement SWOT matrix framework to summarize the environmental factors, both internal and external, currently impacting the Korean shipbuilding industry. Second, I will use microeconomics and Porter's Five Forces analysis to derive strategic implications. Third, I will explain the death spiral that Korean shipbuilders risk facing given the financial conditions. Lastly, some suggestions for Korean shipbuilders will be provided as follows: focusing on offshore units, exploiting new market demand, and considering business diversification as potential business strategies.

Chapter 2 Overview of the Shipbuilding Industry

In this chapter, the history of the modern shipbuilding industry is traced to understand leadership changes during the 20th century. With a close look at the leadership changes, common factors that enabled specific countries to dominate the shipbuilding industry and the reason why they lost their predominant position can be identified. Detailed explanations of main products, the shipbuilding process, and major players in the shipbuilding industry will provide an overall understanding of the shipbuilding industry. Key features of the shipbuilding industry are defined to provide a rationale for potential strategies that Korean shipbuilders can implement.

2.1 History of Modern Shipbuilding Industry

Over the past century, shipbuilding industry has experienced a major shift in geographic distribution from Britain, via U.S. and Japan, to Korea. Before closely looking at the leadership changes in the shipbuilding industry, we need to look at common stages of development of the shipbuilding industry in specific countries that have established the predominant position. In the book, *Korean Shipbuilding Industry: Growth and Mission*, the common stages of development of the shipbuilding industry are summarized as follows:

> Nations that used to be a world leader in the world shipbuilding industry such as Britain, U.S., Japan, and Korea all followed these common stages without exception. The evolution of the shipbuilding industry in those nations was closely related with increased seaborne trade due to their industrial and economic development. Therefore, the development stages of the shipbuilding industry followed a certain pattern.
>
> First, when nations didn't reach a certain level of seaborne trade, they depended upon merchant ships from other nations. When they needed their own ships because of the

increased seaborne trade, they purchased new or second-hand ships from developed shipping countries. Second, as seaborne trade and foreign and domestic ships increased, they started to construct shipyards for repairing. Third, as technologies for repairing ships acquired and the need for domestic ships grew, shipyards for building new ships were constructed. Correspondingly, the steel industry, an upstream industry, grew to meet the demands of steel required for shipbuilding. Fourth, they increased their world market share with a competitive advantage based on cost leadership. Fifth, however, a problem with increased labor costs led the countries to pursue high technologies resulting in cost cutting and improved productivity. Sixth, difficulties stemming from high labor costs and scarcity of skilled workforce eventually made them lose their productive edge and price competitiveness. As they lost their competitive advantages and market share, they depended upon financial supports and government subsidies. Finally, they lost a significant market share in the world shipbuilding industry and just started to build ships for domestic needs. Past leaders U.S. and Britain are in the last stages, Japan is in the middle of fifth and sixth stage and Korea is in the middle of fourth and fifth stage. (193-194)

Also, as shown in table 2.1 below, Porter (1986) summarized the evolution of shipbuilding leadership by competitive advantages and business strategies. The common steps can be described as follows: protection, cost leadership strategy, differentiation or segmentation strategy, government subsidization, and facility reduction.

Table 2.1 Leadership changes in the shipbuilding industry

Country	1940s	1950s	1960s-80s	1990s-2000s	2010~
UK	· Riveting construction method · Cost leadership	· Global differentiation · Non-cost competitive advantages	· Subsidization · Nationalization of shipyards	· Facility reduction	
West Europe		· Cost leadership	· Global differentiation · Restructuring	· Global segmentation · Subsidization · Facility Reduction	
Japan		· Government support and protection · Block construction method	· Cost leadership	· Global differentiation · Non-cost competitive advantage	
Korea			· Government support and protection	·Cost leadership ·Capacity expansion	· Non-cost competitive advantage · Global differentiation
China				· Government support and protection	·Cost leadership ·Capacity expansion

Source: Porter 1986, Hong 2006

The modern shipbuilding industry that is defined by iron structures and steam engines started approximately in the 1860s. Britain firmly established its strong presence in the late 19th century, and it captured 80% of the world's shipbuilding market in 1882 (Porter, Competition in Global Industries 1986). This could be easily inferred by the seaborne trade volume of Britain and the fleets they owned at the same period. As mentioned above, well developed shipping industry is a precondition for the growth of shipbuilding industry. British merchant fleets accounted for 33% of the total world fleets in 1914, and therefore Britain became a world leader both in the shipping market and the shipbuilding market in the 1900s.

Table 2.2 Shipbuilding market share in the 1900s Units: '000 GT

	Merchant Vessels		
	1892-1896	1901-1905	1910-1914
Britain	1,021	1,394	1,660
Germany	87	215	328
U.S.	85	347	253
France	26	123	15
Holland	10	52	97
Japan	3	33	57
Others	67	190	329
World Total	1,299	2,354	2,739
Britain/Total (%)	78.6%	59.2%	60.6%

Source: "Annual Returns," Lloyds Register (London)[3]

[3] Sidney Pollard. (1957). British and World Shipbuilding, 1890-1914: A Study in Comparative Costs. "The Journal of Economic History, Vol 17, No 3", 426-444.

During WWII, the U.S. took the world leadership position away from the Britain. Because the U.S. needed to move long distances across the ocean and came to realize that seaborne support was critical, it expanded shipbuilding capacity and developed many innovations, especially in welding technologies. During WWII, the U.S. employed the electric welding method in building navy ships (Motora 1997). In the period from 1940 to1945, the market share of the U.S. shipbuilding industry reached its unprecedented peak in the world shipbuilding market, accounting for 90% of total production in the world (Lu 2005).

After WWII, Japanese government chose a policy of supporting the recovery of the shipping and shipbuilding industries, since it had lost 80% of vessels because of WWII. The government recovery fund came from the U.S. and the Japan Development Bank made this recovery plan possible. The Korean War in 1950 and the Suez Canal Crisis[4] in 1956 led to a shipbuilding boom in Japan. The outbreak of the Korean War made Japanese ports not only a transport terminal for armed personnel but also a logistical base of the UN forces. Because of the closure of Suez Canal, the tankers needed to make a detour around South Africa instead of passing through the Suez Canal, and therefore shipping companies needed larger tankers to offset the increased distances. Japanese shipbuilders cashed in on this opportunity unlike British shipbuilders (Colton and Huntzinger 2002). In this period, successful development and adoption of block construction[5], with a transition of shipbuilding method from riveting to welding, enabled Japan's shipbuilding industry to establish economies of scale by constructing large ships and effectively expanding their production capacity (Motora 1997). In the 1960s, Japan captured

[4] The closure of the Suez Canal forced vessels, especially oil tankers, to detour around South Africa. Increases of operating costs and disappearance of size constraints caused by Suez Canal led to the growth of tanker size.

[5] In block construction, the ship structure is physically divided into a number of blocks that are constructed and pieced together. Blocks are constructed on land and they are assembled together in a dock. Shipbuilders have been trying to reduce the number of ship blocks in order to enhance productivity because fewer blocks enable for shipbuilders to shorten assembly times. For instance, Samsung Heavy Industries recently announced that it developed "tera-block" method that assembled a ship by two large blocks.

more than 50% of market share in terms of annual completion and strengthened its market leading position. Until 1999, Japan continued to dominate the world shipbuilding market, accounting for 43% of the world completion.

In the 1970s, Korea entered the world shipbuilding market during a shipbuilding boom before the oil crisis. In the 1990s especially, Korean shipbuilders committed themselves to massive capital investments to increase capacity with the confidence that they could acquire competitive advantages over Japanese shipbuilders. In the meantime, in the 1980s, Japan legislated to reduce the capacity of Japanese shipbuilders, and therefore their capacity fell by 37% in 1980, and by 24% in 1988 (Motora 1997). In the 1990s, Japan suffered from an appreciation of the yen and increased labor costs; Korea benefited from the appreciation of the yen and the depreciation of the Korean won against the U.S. dollar caused by the Asian financial crisis. The weakening of the Korean won increased Korean shipbuilders profitability and enabled them to reduce their bidding prices. With reduced prices and increased capacity, Korean shipbuilders increased their market share from 25% in 1998 to 36% in 2000 (First Marine Limited International 2003).

Since 2000, Korea took the first position from Japan and has kept the leading position until now. Meanwhile, China has become the second largest shipbuilder since 2006. It is openly acknowledged that China will soon establish a strong presence in simpler ship types. Furthermore, the competition between Korea and China will become more severe from now on since shipbuilding demand may not increase as expected and shipbuilding supply is in an over capacity stage.

2.2 Main Products

The main categories of merchant ships are cargo ships, passenger ships, and special offshore units. Cargo ships can be categorized by freight they carry, and further by their relative size. As seen in table 2.3 below, Cargo ship products can be broadly divided into wet cargo ships and dry cargo ships. The wet cargo ships, so-called tankers, consist of crude oil tankers, gas carriers, and chemical tankers; the dry cargo ships consist of bulk carriers, container ships, and others. In addition, there are offshore units such as drill-ships, FPSOs, and FSRUs[6].

Table 2.3 Main product types

Category		Types	Carriage of freight
Cargo	Wet Cargo	Crude Oil Tanker	Crude Oil
		Product Carrier	Oil Derivatives (Petroleum, Kerosene, Diesel)
		Chemical Tanker	Naphtha
		Gas Carrier	LPG, LNG
	Dry Cargo	Bulk Carrier	Iron Ore, Coal, Grain, Cement
		Container Ship	Container
Passenger		Ferries, Cruise	
Offshore Units		FPSO	Floating Production, Storage and Offloading
		Drillship	Offshore Drilling Unit
		LNG FSRU	Floating Storage & Regasification Unit

Source: The Korea Shipbuilders Association

The differentiation for each class within ship types in the table 2.4 are based on common industry usage which is considered as the standard. The substitution among classes is rarely

[6] Offshore units can be divided into drilling units and production units. Offshore drilling units are drill-ships, semi-submersible rigs and jack-up rigs. Offshore production units are FPSOs, FSRUs, and platforms (oil, gas). FPSOs are designed to receive oil or gas produced from nearby platforms, process it, and store it until the oil or gas can be offloaded onto oil tankers or transported through pipelines.

possible because of economies of trade (First Marine Limited International 2003). In the operation of shipping, the fixed cost could be reduced by operating a VLCC instead of operating two Aframax[7] tankers.

Table 2.4 Size categories of oil tankers and bulk carriers

Oil Tanker Class	Size in DWT	Bulk Carrier Class	Size in DWT
Panamax	60,000 ~ 80,000	Handy Size	10,000~35,000
Aframax	80,000 ~ 120,000	Handymax	35,000~55,000
Suezmax	120,000~200,000	Panamax	60,000~80,000
VLCC	200,000~320,000	Capemax	80,000 and over
ULCC	320,000~550,000		

Source: Wikipedia

As shown in table 2.5 below, Porter (1986) categorized ship types based on the level of sophistication. Oil tankers are the simplest ships and passenger ships and oil rigs are the most complicated ships in merchant fleets.

Table 2.5 Buyers' main purchase criteria

Ship Category	Sophistication	Purchase Criteria			
		Price	Delivery	Quality	Government
Oil Tankers	Low	8	2	0	0
Bulk Carriers	⇕	7	3	0	0
General Cargo	⇕	6	3	1	0
Containers	⇕	4	3	3	0
Gas Carriers	⇕	2	2	6	0
Passenger Ships	⇕	1	2	7	0
Oil Rigs	⇕	1	3	3	3
Navy Ships	High	0	1	4	5

Source: Porter 1986

[7] AFRA stands for 'American Freight Rate Association'

A notable thing is that oil tanker buyers consider price an important criterion, which means that the buyers who want to award an oil tanker contract are cost sensitive rather than quality sensitive. In this regard, if shipbuilders focus on premium ships for their product mix, they can be free from severe price competition to a certain degree.

As shown in figure 2.1 below, the relative portion of product categories changed gradually. The relative portion of tankers and bulkers decreased, whereas gas carriers and containers increased their portions up to 12% and 24%, respectively. Considering the fact that the portion of sophisticated ships has been increased, segmentation strategy that focuses on these ships will increase shipbuilders' profitability.

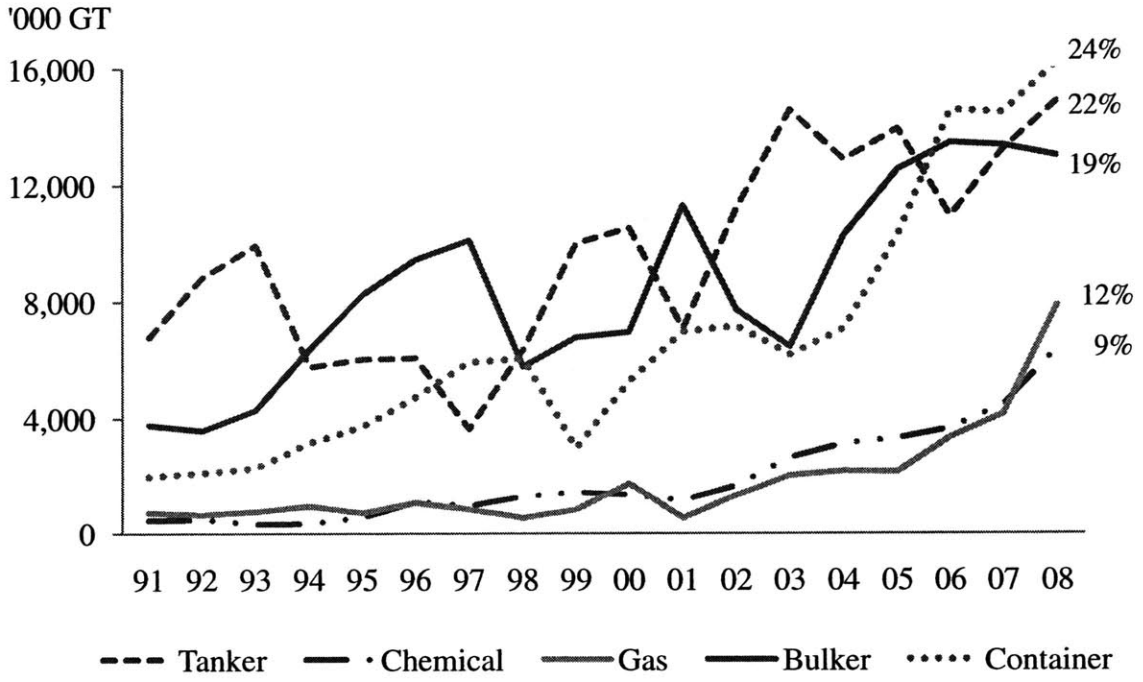

Figure 2.1 World completions by ship types (Source: The Shipbuilders' Association of Japan)

2.3 Shipbuilding Process

According to the theory of constraints (TOC), if a company has limited capacity in a

specific process and additional capacity that can't be obtained in the short run, the company should try to increase contribution margin and asset turnover per constrained resource. Since one of the major bottle necks in shipbuilding processes is erection stage in a dock and it takes more than 2 years to build additional dock, improving operational efficiencies in the dock is critical for the shipbuilder to increase profitability. As such, shipbuilders improved operation efficiencies by developing fabrication method to build 4 or 5 ships in a dock at the same time. They tried to reduce the number of ship blocks fabricated in the dock. Bigger- and thus fewer- blocks enabled shipbuilders to shorten the assembly time.

In addition, in order to increase the efficiency of production facilities, the period in the dock has been shortened by process innovations. Outfitting and painting stage are now undertaken before the erection stage. If outfitting[8] and painting processes are done in advance as much as possible, the time in the dock and the waiting time can be reduced substantially.

Table 2.6 Shipbuilding process and building period Unit: Month

Contract	Design	Production			
		Pre-Stage	Yard	Dock	Quay
· Bid Proposal · Discussion on the Specifications and Agreement	· Basic · Detailed · Production	· Production Plan · Procurement	· Steel Cutting · Block Assembly · Pre-Outfitting · Painting	· Erection · Launching	· Outfitting · Trial Run · Delivery
Large Containers	11.0		4.5	2.5	3.0
LNG Carriers	12.0		5.5	2.0	8.5
Drill-ships	12.0		5.5	1.5	10.0

Source: IR reports

[8] Pre-outfitting: Installation of the systems, equipments, and fittings into the ship before the erection of the blocks

2.4 Major Shipbuilders

Table 2.7 below provides the distribution of order book reported in the main shipbuilding countries and shipbuilders at the end of 2009. In 2009, China achieved 35% market share, and slightly surpassed Korea in terms of order book. Compared to 2000 statistics where China's market share was only 7%, the 35% market share is a result of substantial growth.

Table 2.7 Order book by countries and shipbuilders as of 2009

Rank	Country	Mil.CGT	%	Company	Country	Ship	Mil.CGT	%
1	China	54.7	34.9	Hyundai H.I	Korea	219	8.6	5.5
2	Korea	53.8	34.3	Samsung H.I	Korea	179	8.4	5.4
3	Japan	24.3	15.5	Daewoo	Korea	174	8.1	5.2
4	Philippines	2.5	1.6	STX	Korea	168	4.8	3.1
5	Vietnam	2.3	1.5	H. Mipo	Korea	203	4.2	2.7
6	India	2.2	1.4	H. Samho	Korea	113	4.2	2.7
7	Germany	2.0	1.3	Dalian	China	105	3.4	2.2
8	Italy	1.6	1.0	Jiangnan	China	109	3.0	1.9
9	Brazil	1.3	0.8	Jiangsu	China	81	2.7	1.7
10	Turkey	1.3	0.8	Sungdong	Korea	85	2.4	1.5
	Other	5.2	3.3	Other		6,832	106.9	68.2
	Total	156.7	100	Total		8,268	156.7	100

Source: Clarkson

However, the world shipbuilding market is still dominated by Korean big players. Their production capacities are almost two times greater than other shipbuilders' capacities in China and Japan. It means that Korean shipbuilders enjoy more competitive advantages by economies of scale than other shipbuilders in China and Japan. Furthermore, an average CGT[9]

[9] CGT is modified the GT by a compensation factor relating to the complexity of the building process. Refer to Appendix 1.

(Compensated Gross Tonnage) per ship of Korean shipbuilders' order book is 28,600[10] which is 1.7 times greater than that of Chinese shipbuilders', 16,800. Considering the concept of CGT, Korean shipbuilders are building 1.7 times more complicated or bigger size vessels than Chinese shipbuilders.

Even though the shipbuilding industry has experienced geographic leadership changes, Europe, Japan, Korea, and China still have their competitive advantages in specific product categories. The figure 2.2 below graphically provides the major products they build and relative size and complexity of ships.

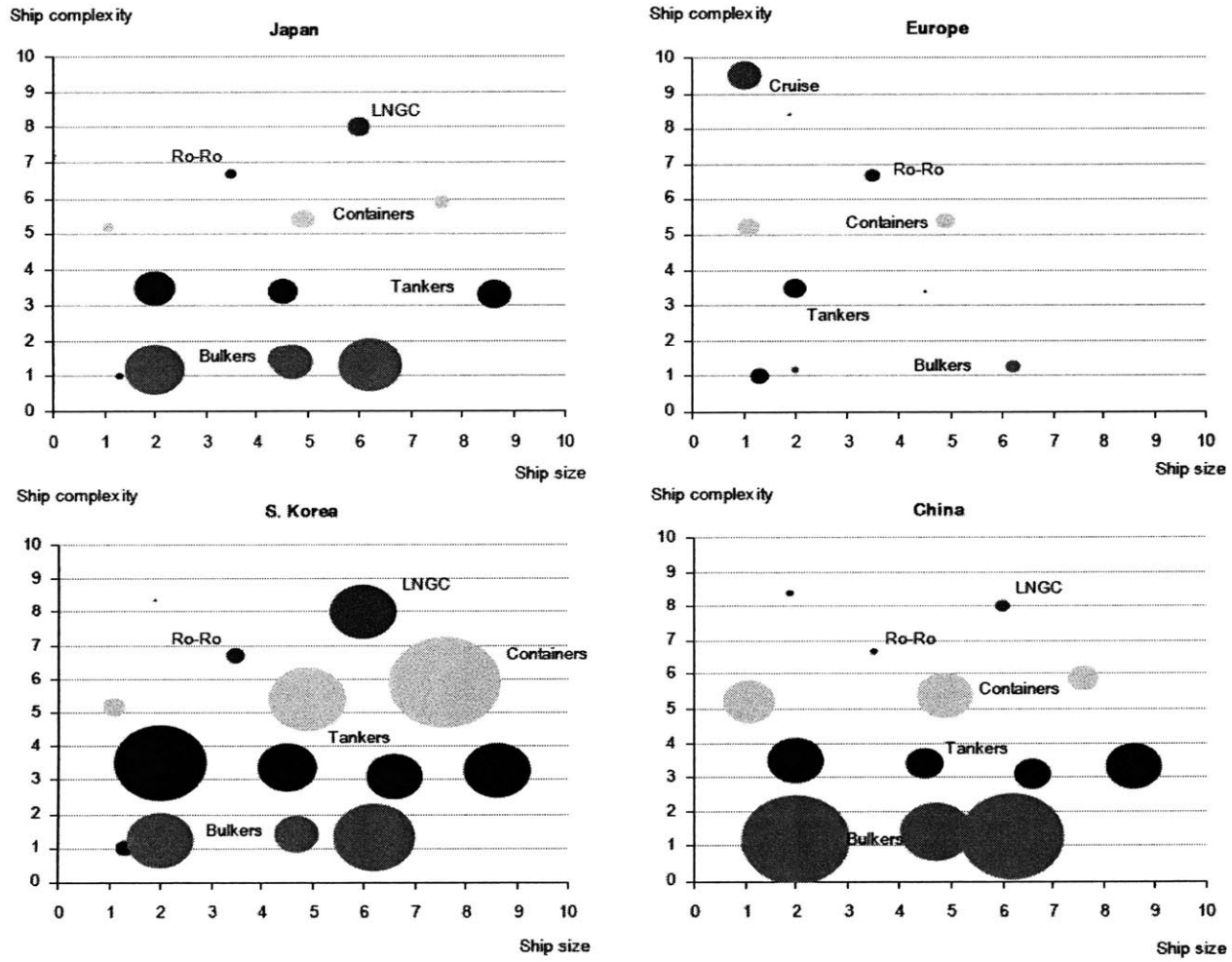

Figure 2.2 Order book mix by region (Source: Clarkson)

[10] Total CGT of order book / Total number of ships

Chinese shipbuilders' major product category is bulkers; Korean shipbuilders' major product categories are tankers, containers, and gas carriers. In containers, economies of scale in shipbuilding costs and shipping costs per TEU[11] lead ship buyers to place orders of large containers. Korean shipbuilders concentrate only on large containers, because a handful of Korean shipbuilders are able to build them, and therefore price competitions in large containers are not as severe as those in bulkers and medium-sized containers.

Despite high labor costs, Europe still has a strong presence in cruse ships, and this simple fact speaks of where the business opportunity lies for Korean shipbuilders.

2.5 Key Features of the Shipbuilding Industry

2.5.1 Cyclic Industry

As presented in figure 2.3 below, there were three peak seasons during the latter half of the 20th century. The main reason for the first peak in 1940s can be explained by WWII. The unprecedented peak in 1975 that can be explained by the closure of Suez Canal was followed by a collapse in demand stemming from the oil crisis of 1973 in conjunction with an industrial crisis that followed. The latest boom in 2000s was triggered by several factors. First, the steady world economic growth, especially China's growth, was the main reason. Second, the demand to replace old vessels with new ones was increased by IMO[12] regulation that limited the lifespan of ships to 28 years. Third, another IMO regulation that, in order to prevent or reduce oil spills, single hull tankers should be substituted for double hull tankers by 2010 propelled the demand.

[11] TEU (Twenty-foot Equivalent Unit) is the basic measurement of the cargo carrying capacity of a container ship. 10,000 TEU container ships can carry 10,000 containers at most.
[12] International Maritime Organization is the UN's specialized agency responsible for the global regulation of international shipping

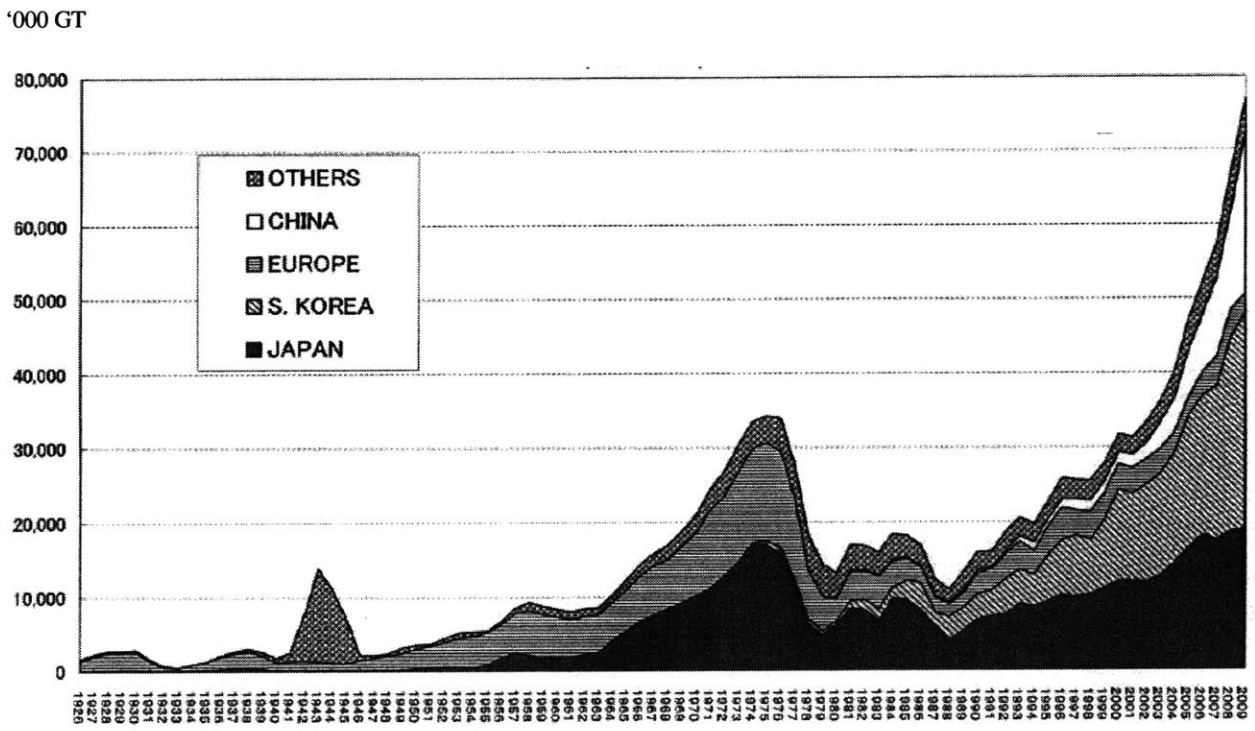

Figure 2.3 Cycle of shipbuilding industry in terms of annual completion
(Source: The Shipbuilding Association of Japan)

2.5.2 Massive Investment

For shipbuilding, infrastructure and manufacturing facilities such as docks, cranes, quay walls, and machinery are needed. Beyond upfront investments, constant annual capital expenditure is required to increase shipbuilding capacity and to enhance productivity. As shown in table 2.8 below, over a period of five years from 2005 to 2009, Korean shipbuilders invested aggressively to catch up with the substantial increase in shipbuilding. In 2008, the percentage of investment reached up to 10% of total exports.

Table 2.8 Investment in Korean shipbuilding industry Unit: Billion $

Item	2005	2006	2007	2008	2009
Investment (Percentage)	1.1 (6.2%)	1.5 (6.8%)	2.4 (8.7%)	4.3 (10.0%)	4.0 (8.9%)
Exports	17.7	22.1	27.7	43.1	45.1

Source: The Korea International Trade Association, Korea Development Bank (1,100Won/1$)

2.5.3 Highly Competitive Market

The shipbuilding market can be defined as a highly competitive market. It has a relatively high entry and exit barrier because of huge initial investment but has no residual value of fixed assets. In addition, even though ship buyers have similar needs for certain type of ships, shipbuilders can offer distinguishable ships in terms of quality and performance

On the other hand, the shipbuilding market has a characteristic of perfectly competitive market such as numerous sellers and buyers who are price takers. Bulk carriers and tankers, for instance, are so standardized that shipbuilders can't be price makers.

Also, shipbuilding market is single global market with information symmetry. In 1986, Porter explained that the single global market was due in part to high ship prices compared to relatively low transportation costs. For instance, prospective ship owners can generally place a new order with a shipbuilder who offers the best deal from anywhere in the world, and therefore the price of ships eventually converged on a certain level. As a result, when a shipbuilder offers the bidding price that is noticeably out of alignment, the shipbuilder will be squeezed out from the shipbuilding market.

2.5.4 Long Term Project

A shipbuilding contract is a rather long-term contract that needs more than two years from a signed contract to a delivery. Because of this long-term characteristic, there are several risks that shipbuilders are face with.

First, shipbuilders are exposed to risks such as price fluctuation of steel plates and equipments that are more than 15% and 50% of total COGS, respectively. Generally, it takes more than one year from the date of contract signing to the date of steel cutting.

In addition, shipbuilders are confronted with an installment payment risk. Typically, equal installment payments[13] of 20% are made in five stages[14] during the contract period. Considering the time value of money, the payment method will have a significant cost implication for both the owner and the builder. If the payment method is changed into 'Tail End', the time value of money should be taken into account in the final contract price[15].

The shipbuilding contract is usually based on foreign currency, mainly U.S. dollars. Without hedging the foreign currency by derivatives, the profit of shipbuilders will be volatile as a result of the fluctuation of foreign currencies.

2.5.5 High Volatility of Price

The high volatility of ship prices is not only a key feature of shipbuilding but is also a result of all key features mentioned above. However, a main reason for the high volatility of ship prices can be summarized as inelastic supply in the short run. Because of this inelastic supply,

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[13] The traditional payment method is composed of a standard, a heavy-tail, a top-heavy method. For instance, the heavy-tail method consists of four payments of 10% with the remaining 60% due at delivery.

[14] The five stages comprise dates of contract signing, steel cutting, keel laying, launching, and delivery.

[15] The size of ship financing market decreased dramatically because of the financial meltdown in 2008, and therefore ship buyers may suffer from increased financial costs. As a result, the preferred payment terms of shipbuilding contracts may shift from the standard payments to heavy-tail payments. This payment shift will cast burden on shipbuilders with financial costs.

the shipbuilding market responds to changes by means of price adjustment rather than output adjustment. There are several reasons why the shipbuilding supply curve is inelastic.

First, it takes at least two years to increase additional capacity. Even if shipbuilders overcome space, labor and financial constraints, capacity addition requires long planning and construction period. Second, it is not easy for the firms to exit the shipbuilding industry because of the high exit barrier. The fixed assets in shipbuilding industry is so specialized that the usage outside the industry is limited. The market value of fixed assets such as cranes and welding machines is far less than the investment value, so-called value in use. At last, the shipbuilders can't flexibly adjust the production output by stockpiling inventories. Without new orders, they have to stop production activities instantly.

2.6 Summary

Considering the evolution of the shipbuilding industry, the major factor for a country to become a world leader was cost leadership. Also, the geographical shifts in the industry demonstrates that the cost leadership strategy is difficult to sustain for an extended period of time, which means that Korean shipbuilders should reconsider their business strategy to cope with the remarkable growth of China.

The main types of ships can be categorized by the level of sophistication. Bulkers and tankers are simpler ships; Gas carriers, offshore units, and cruise ships are sophisticated ships. When considering the order book mix, China captured a significant market share in simpler ships such as bulkers and mid-sized containers. Korean shipbuilders should implement segmentation strategies focusing on sophisticated ships to avoid severe price competitions. Despite high labor costs, Europe still has a strong presence in cruise ships, and this simple fact speaks of where

Korean shipbuilders should enter.

The key features of shipbuilding industry can be categorized as follows: cyclical industry, massive investment, highly competitive market, long term projects, and high volatility of shipbuilding price. It can be easily inferred that shipbuilders has went through the fluctuation of profitability because of these key features. As such, from the long term perspective, finding other profit drivers to reduce the fluctuation is critical for shipbuilders.

Chapter 3 Major Factors for Performance

In this chapter, I will identify major external and internal factors that affect shipbuilders' performance. The external factors will be analyzed by how they affect shipbuilders' profitability and the internal factors will be explained as to why they can be competitive advantages for shipbuilders. The identification of major factors will be a basis for SWOT analysis in Chapter 7.

3.1 External Factors

3.1.1 Exchange Rate

Considering that most of the shipbuilding contracts are made by U.S. dollar basis, the exchange rate between local currency and U.S. dollar is a critical factor for the shipbuilders. In addition, the importance of hedging exchange rate is amplified when shipbuilders sign foreign currency based contracts and procure materials and equipments in local currency from domestic suppliers. Net exposure of currency risks increases because of no opportunity to automatically offset foreign currency inflow by outflow. Therefore, of late, most of Korean shipbuilders are trying to cover currency risks by taking long or short positions in derivatives[16] or shifting the contract basis from the U.S dollar to the local currency.

However, the spot exchange rate on the contract date is critical for shipbuilders' profitability even though they hedge currency risks. When a shipbuilder enters a forward contract on the contract date, the forward exchange rate of derivatives inherently reflects the spot exchange rate on the contract date. For instance, the forward exchange rate is higher when the spot exchange rate is 1,200 Won/$ rather than 800 Won/$.

[16] When a shipbuilder wins an order, it enters a US dollar short forward contract, whereas a financial institution assumes a US dollar long forward position. For U.S dollar outflow, a shipbuilder enters an opposite position.

Table 3.1 Hedging policies of major shipbuilders

Company	Hedging Policy by Derivatives
HHI	Over 80% of net exposure
SHI	100% of expected cash inflow & outflow
DSME	Over 90% of net exposure

Source: Annual Reports

Because of the depreciation of Korean won caused by Asian crisis that erupted in mid-1997, Korean shipbuilders gained huge profits by entering U.S. dollar short forward contract. The Korean won, meanwhile, weakened to more than 1,700 won per dollar from around 800 won per dollar. At the same period, however, the exchange rate for Japanese yen to U.S. dollar increased only 20%. Even though the Korean economy suffered severely from Asian financial crisis, Korean shipbuilding industry, paradoxically, benefited from the decline in currency. Korean shipbuilders could increase their sales and profits from the new contracts that were signed at the high exchange rate. As such, during that period, Korea took the market lead by winning over a portion of the market of Japanese shipbuilders.

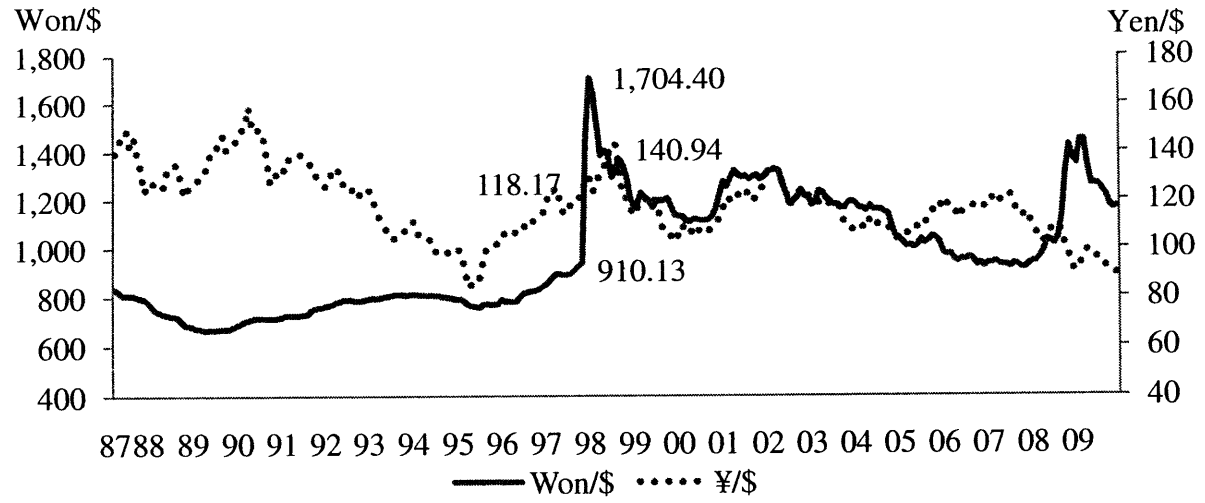

Figure 3.1 Exchange rates to the U.S. dollar (Source: The Bank of Korea)

3.1.2 Global Growth Rate & Seaborne Trade

GDP, seaborne trade, and shipbuilding price were closely related. In fact, overall GDP growth rate impacted the volume of seaborne trade and sequentially, the volume of trade affected the shipbuilding demand and price. As a result, as shown in figure 3.2 below, the degree of their volatilities, so-called standard deviations, increased in an order of GDP, seaborne trade, and shipbuilding price index. The standard deviation of shipbuilding price index is 11.0%, 8 times greater than that of GDP, 1.4%.

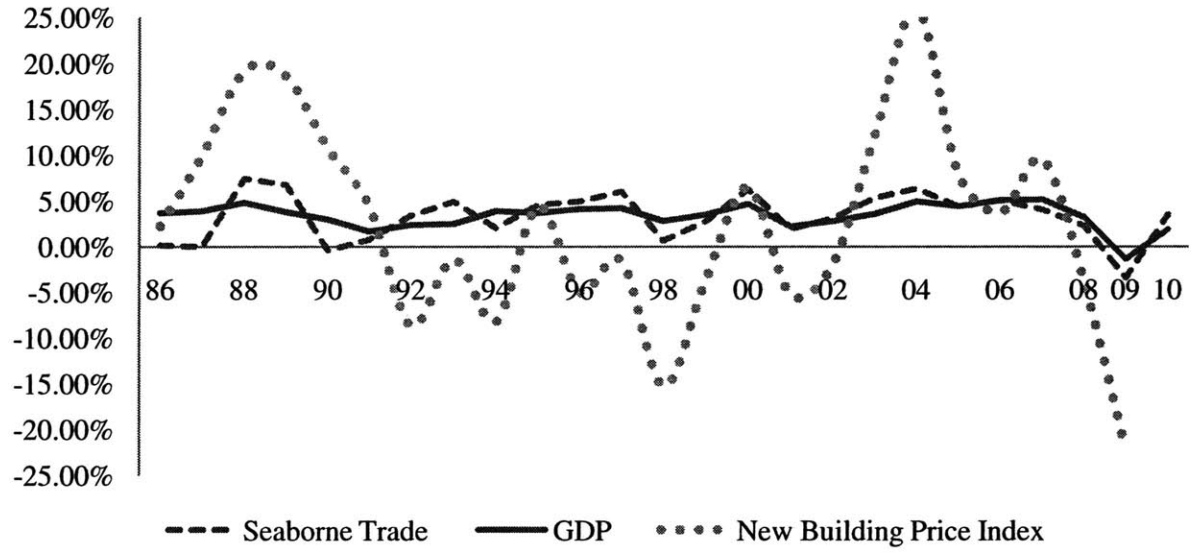

Figure 3.2 Correlation among GDP, seaborne trade, and shipbuilding price index
(Source: Clarkson, IMF, Korea Maritime Institute)

3.1.3 Steel Price

The main portion of shipbuilding costs is material costs[17] that can be broken into steel and equipment costs. As such, the increase of steel price can have a detrimental effect on the

[17] Material costs consist of more than 50% of total costs approximately. (Based on Schedules of Cost of Goods Manufactured of Korean shipbuilders in 2004)

profit of shipbuilders. Steel costs are approximately 15% of COGS and 13% of sales[18], which means that a 10% increase in steel price can decrease gross margin by 1.3%. Unlike exchange ratio, steel is a difficult commodity for the shipbuilder to hedge against the volatility of the price.

As shown in figure 3.3 below, if a shipbuilding contract had been signed in 2007 and constructed in 2008, the loss from that contract would have been huge because of doubled steel price. On the other hand, if the contract had been signed in 2008 and constructed in 2009, the result would have been opposite.

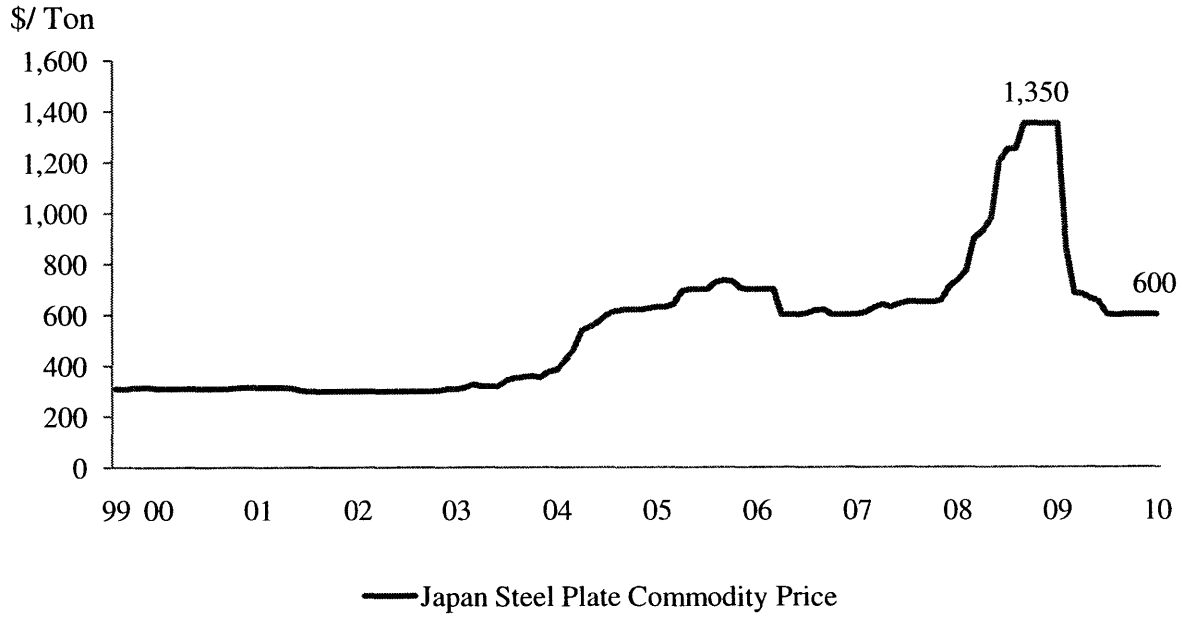

Figure 3.3 Japan steel plate price (Source: The Korean Maritime Institute)

3.1.4 Oil Price

In the 2000s, because of the Iraq War, Hurricane Katrina, and concerns about the shortage of oil, oil prices skyrocketed up to $150 per barrel. This rise in oil prices had both a positive and a negative effect on the major shipbuilders in Korea. The positive effect was that oil majors, with

[18] 15%*(1-Gross margin)

a rosy prospect of high oil prices, awarded a lot of offshore plant and drillship contracts and Korean shipbuilders won most of these contracts. HHI, for instance, accomplished 11% increase in offshore division's sales in 2009, and extended offshore division's sales portion up to 16% of total sales.

In the meantime, considering the fact that oil is needed to operate facilities and to test driving performance before delivery, the rise in oil prices can be a cost burden to the shipbuilders. Also, the high oil price can reduce the volume of seaborne trade and sequentially, the reduced seaborne trade will affect the demand for shipbuilding.

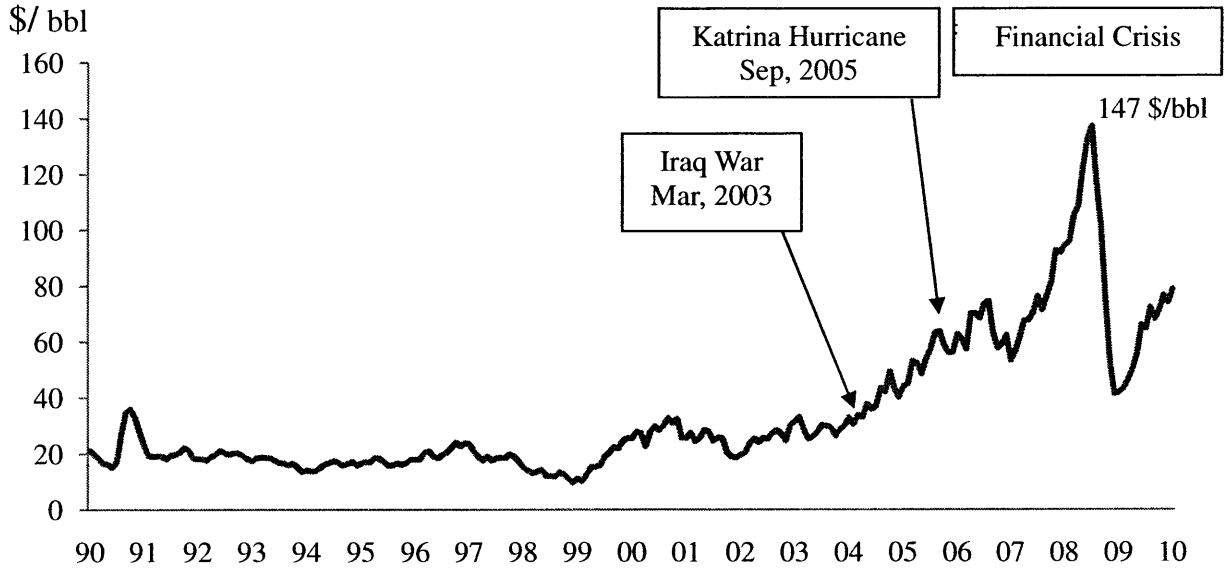

Figure 3.4 Crude oil price (Source: Korean Ministry of Knowledge Economy)

3.1.5 Domestic Shipping Industry

As mentioned above, the shipbuilding industry has been heavily affected by seaborne trade influenced by the global economic growth. On the flip side, if domestic shipping industry is owns a large number of ships, the fluctuation of the domestic shipbuilders' performance will be

decreased. As seen in other industries, during market downturn, protective trade policies will be strengthened. For instance, domestic shipping companies can award contracts to their local shipbuilders under government supports. Two major Chinese shipbuilders, CSSC and CSIC, are state-owned companies. In case of domestic ships, Chinese government subsidizes 17% of ship price to two state- owned shipbuilders. Also, in 2009, 43% of Japanese shipbuilders' orders booked came from the domestic shipping companies and this portion is expected to increase.

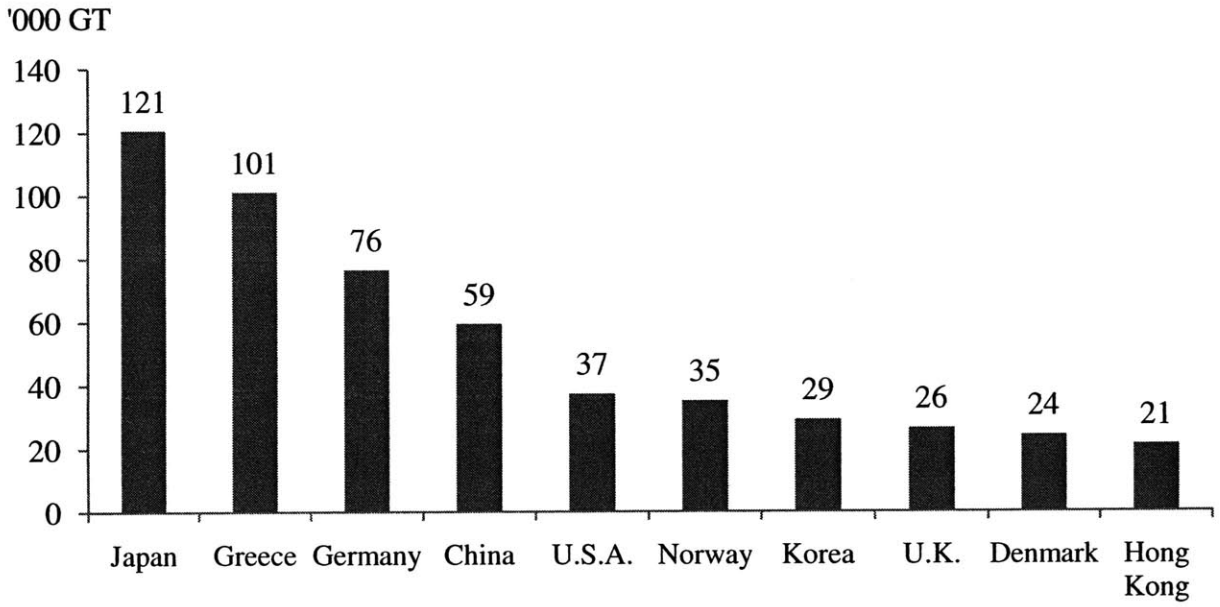

Figure 3.5 World fleet by nationality of owners (Source: Lloyd's Register of Shipping)

Table 3.2 Domestic portion in the order book

	Japan	Korea	China
Domestic Portion (Rank)	43% (1)	7% (3)	23% (1)

Source: The Shipbuilder's Association of Japan

3.2 Internal Factors

3.2.1 Workforce

As the shipbuilding industry is characterized as labor intensive, a skilled workforce is the first requirement for shipbuilders to increase their competitive edge. The most important factors in evaluating the workforce are as follows: total number of workers, skill level of workers, constant supply of workers, and average age of workers. Especially, since the shipbuilding industry's workers acquire technical skills by training and field experiences, maintaining a constant supply of workers and low average age are the best ways to prevent productivity from decreasing. For instance, Japanese shipbuilders are expected to lose their productive edge because of skilled- but aged- workforce. If this aged workforce is retired in the foreseeable future, Japanese shipbuilders will suffer from decreased productivity.

3.2.2 Technology

Shipbuilding technology can be categorized as production, design, and management technology. It can be easily assumed that the production technology is directly related to the productivity. However, the design technology, including basic, detailed, and production design is critical not only because it is required for reducing reworks but also because it can immediately reflect customers' needs. Recently, in high value added ships such as offshore units, the shipbuilder's ability to reflect change orders requested by customers during production is important. Also prompt and precise design ensures that shipbuilders receive much leeway to manage procurement and production processes within the lead time.

3.2.3 Economies of Scale

Economies of scale means that the average fixed cost per ship declines with production increase. To achieve economies of scale, a main profit driver, in the shipbuilding industry, the shipbuilder should satisfy two pre-conditions. First, the shipbuilder should increase building capacity by constant investments. Second, the market demand should be enough to meet the increased capacity.

In the shipbuilding industry, the major fixed cost items consist of depreciation expenses, indirect labor costs, property taxes, and insurance expenses. As a rule, the shipbuilding companies have a high fixed cost structure due to high depreciation expenses resulting from huge investments.

3.2.4 Product Mix

As mentioned above, values that can be created vary according to the type of ships built. As shown in table 3.3 below, the more complicated ships are to build, the more the values that can be created. The shipbuilders should increase the proportion of high value added ships in their product mix, if they don't have cost advantages anymore.

Table 3.3 Comparative added value per each ship type Unit: $, CGT

Ship Type	Bulk Carrier	Tanker	Container	LNG Carrier
Added Value per CGT	290	390	500	680

Source: First Marine International Limited (2003)

Note: Added Value = price – materials and subcontract costs – contract financing costs – other direct costs = labor costs + overhead costs + interest + depreciation + profit

3.3 Summary

Most of the shipbuilding contracts are made by U.S. dollar basis, hence hedging currency risks is critical for shipbuilders' performance. Also the exchange rate level directly affects the shipbuilders' profitability. The volume of seaborne trade affects the shipbuilding demand and prices. Steel costs comprise 15% of COGS so that a 10% increase in steel price decreases 1% of shipbuilders' profitability. Even though the rise in oil prices reduces the volume of seaborne trade, it increases orders of offshore units.

Internal factors that affect shipbuilders' profitability are the level of workforce, technology, economies of scale, and product mix. Korean shipbuilders have kept competitive advantages in these internal factors, and therefore they could generate more profits than Chinese and Japanese shipbuilders. I will explain in detail in Chapter 5 and 6.

Chapter 4 Market Analysis

In this chapter, I will analyze the current market situation in terms of demand, supply, and price. I will then project a market forecast for the coming five years. Market analysis will provide clear evidence why Korean shipbuilders should reconsider their business strategies including investment strategies.

4.1 Current Market Situation

Unlike the Asian financial crisis in 1997, the effect of financial crisis in 2008 spread globally, and caused a total collapse of demand in the shipbuilding industry. Before looking closely at the current market situation, let's briefly examine the nuts and bolts of the shipbuilding industry cycle. The basic frame of the cycle is presented in figure 4.1 below; currently, the shipbuilding industry is at 'New Orders Decrease Stage'. Shipbuilders and ship owners are two participants in the market as suppliers and customers. The freight rate is equivalent to income that decides the ship owners' wealth. Demolition of ships are accelerated or delayed to adjust shipping capacity but has a limitation because of constrained facilities for demolition.

Considering that more than 2 years are needed to increase additional shipbuilding capacity, the available time frame to increase shipbuilding capacity in response to increase of new orders is short. It means that shipbuilders should commit investments in advance, and therefore the early investment has a risk to cause a disparity between shipbuilding capacity and demand.

A more serious problem is that the long time lag between 'Demolition Accelerated Stage' and 'Under Fleet Stage' makes recession rather longer. Some possible ways to reach market

equilibrium are reductions of the shipbuilding capacity, increases in overall shipping market, or increases in demolition volume. However, shipbuilders may not reduce their facilities voluntarily; the demolition volume may not increase in a short term because of constrained facilities and age profiles of current fleets. In addition, if the seaborne trade doesn't increase enough for the shipping companies to increase their utilization rates, the shipbuilding demand may not recover soon. I will explain later in detail with numerical data.

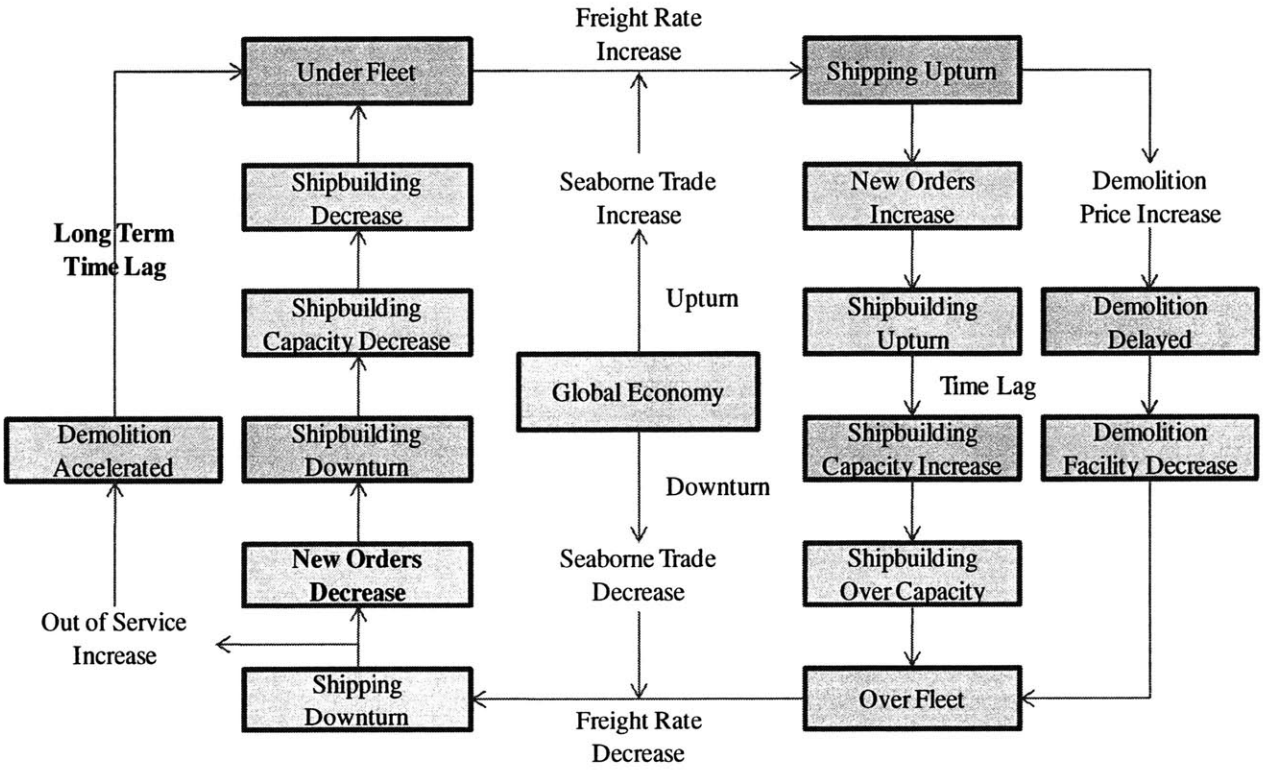

Figure 4.1 Dynamics of shipbuilding industry
(Source: Korea Institute for Industrial Economics & Trade, Edited by Author)

4.1.1 Demand Perspective

In 2009, the shipbuilding industry experienced an unprecedented downturn so that new orders have collapsed, with new orders down 90% to 9.8 million CGT; new building price index

also decreased by 27% from 190 to 138. Historically, it is true that fluctuations in shipbuilding prices and volume have generally mirrored the volume of global seaborne trade, which is ultimately driven by global GDP growth. However, even though the world growth rate, as predicted by OECD, turns positive in 2010 and years to come, the drastic shrinkage in the shipbuilding demand may not easily recover. The reasons are as follows.

First, the current fleet volume itself is in an oversupply stage due to the recent peak season. Over the past six years, the current fleet volume increased at a 6.7% CAGR, reaching over 1,300 million DWT in 2009 from 870 million DWT in 2003. Considering 3.1% CAGR of seaborne trade during the same period, the shipbuilding market was overheated in recent years.

In addition, the order book/current fleet ratio reached 49% in 2008, significantly above the historical average of 10%[19]. Considering the fact that current order book will be delivered in the coming four years, the fleet volume will reach 1,600 million DWT in 2013[20]. Until the order book level and the current fleet volume are decreased to a reasonable level, shipbuilding order may not increase dramatically.

To decrease the current fleet volume, the demolition of ships has to be accelerated. However, considering that the average life span of a ship is 25 years and 67% of ships were built after 2002[21], the demolition rate of ships may not increase in a short term. It will take much more time than expected to decrease the number of both the ships already in the market and the ships ordered but not delivered.

Second, the substitution demand of single hull tanker for double hull tanker and the substitution demand of old vessels built in 1970s, the peak for new vessels, is almost in a final stage. Considering that the substitution demand was one of the main reasons for the recent peak,

[19] An average of 25 years before 2002
[20] Detailed explanation is given in the chapter of market forecast.
[21] It includes new orders that is in the order book and excluded the demolitions expected until 2013.

the increase in demand might be restricted.

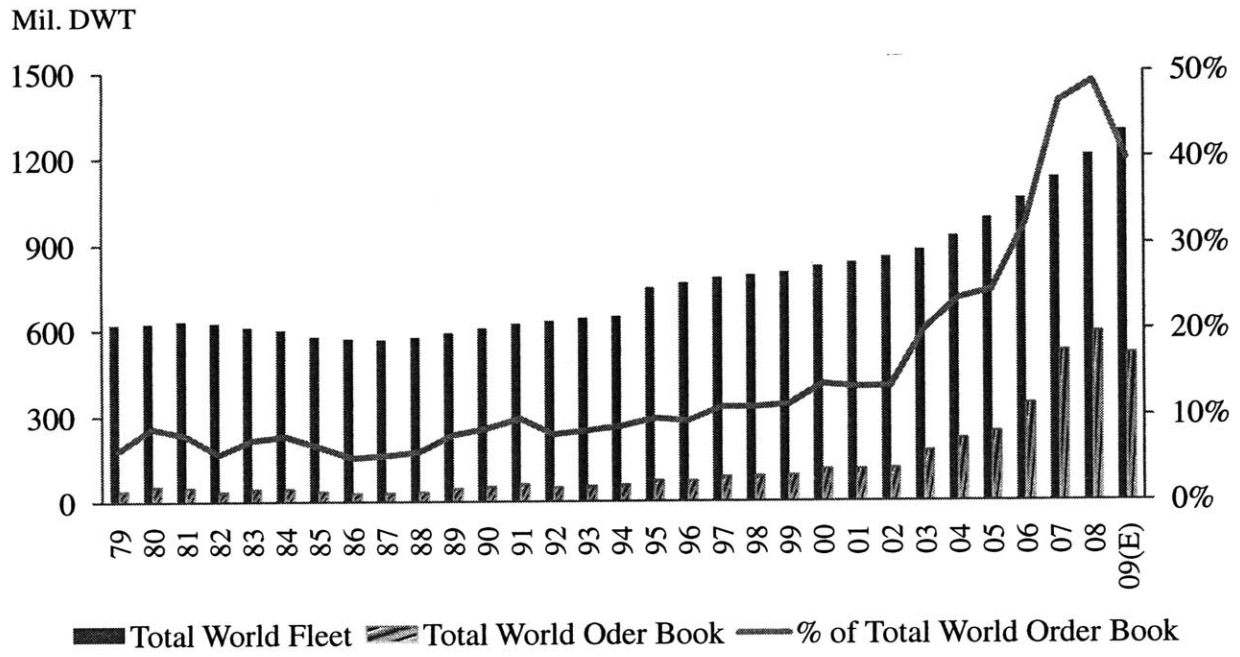

Figure 4.2 Trend of total world fleet and order book (Source: Clarkson)

Third, freight rate, shipping companies' income, should be recovered. According to the microeconomic theory, in industries where customers' income or wealth affects their willingness to pay a lot, market demand tends to be highly cyclical (Corts and Rivkin 2000). From the ship owners' perspective, purchase costs of ships, rather than operating costs, constitute the major portion of capital expenditure. The ship owners need to raise substantial capital in order to purchase a ship, whereas they can operate their business without a huge outlay of cash in the short term. In this sense, the fact that Baltic Dry Index[22] is at only 3,204 that declined from its peak of 11,440 in 2008 provides that the shipping industry suffers from lower freight rates and therefore may hesitate to commit a huge investment incurred in placing new orders.

Fourth, the ship-financing market recovering from financial crisis is a pre-condition for

[22] The Baltic Dry Index (BDI) is a number issued daily by the London-based Baltic Exchange. Not restricted to Baltic Sea countries, the Index tracks worldwide international shipping prices of various dry bulk cargoes.

an eventual recovery in shipbuilding demand. In 2009, the total of top 10 financial institutions that loaned ship finance decreased from $64 billion to $9 billion (Lee 2009). A shipbuilding project is rather capital intensive and shipbuilding contracts are highly leveraged, with more than 70% of payments financed by debts. As such, financial institutions want to diversify the default risk of a shipping company by forming syndicated loans. In ship finance, these syndicated loans played an important role in increasing the demand of ships. Actually, Yun, a researcher at Korean Capital Market Institute, explained that the correlation between the amount of ship finance and new orders is 0.8.

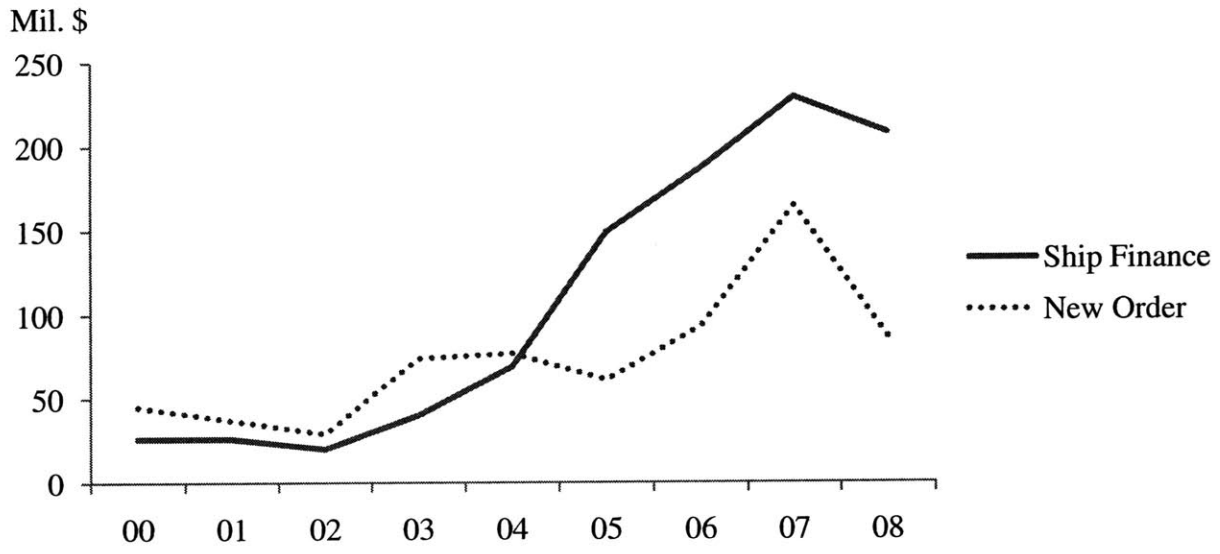

Figure 4.3 Correlation between ship finance and new orders
(Source: Korean Capital Market Institute (Jong-Moon Yun), Lloyd's Register)

Other than estimates of the decrease in new orders, building prices, and seaborne trade volume, there is strong evidence that the shipbuilding industry is in a down cycle. According to the Clarkson research, the number of ships sold for demolition[23] in 2009 was 953, two times more than in 2008. As shown in table 4.1 below, total demolition in 2010 will reach up to 53

[23] The ship demolition is a type of ship disposal involving the breaking up of ships for scrap recycling, with the hulls being discarded in ship graveyards.

million DWT. This estimate shows that shipping companies are deciding to dispose old ships to reduce maintenance costs, which means that they can't even recoup their variable costs. However, the demolition volume expected in 2010, 53 million DWT, is only 3% of total fleet volume, which means that the demolition volume will not boost new orders substantially.

Table 4.1 Trend of total demolitions Unit: Mil. DWT

Year	2005	2006	2007	2008	2009	2010E	2011E
Total	6	7	6	14	31	53	21

Source: Clarkson

It is true that there are also positive indications that market demand may rebound in a short term. Firstly, if appreciation of the Euro against the dollar continues, it will give a positive effect on new shipbuilding price and demand. Appreciation of the Euro against the U.S. dollar has a positive influence on shipbuilding demand because 60% of ship buyers are European companies and shipbuilding contract is usually on a U.S. dollar basis.

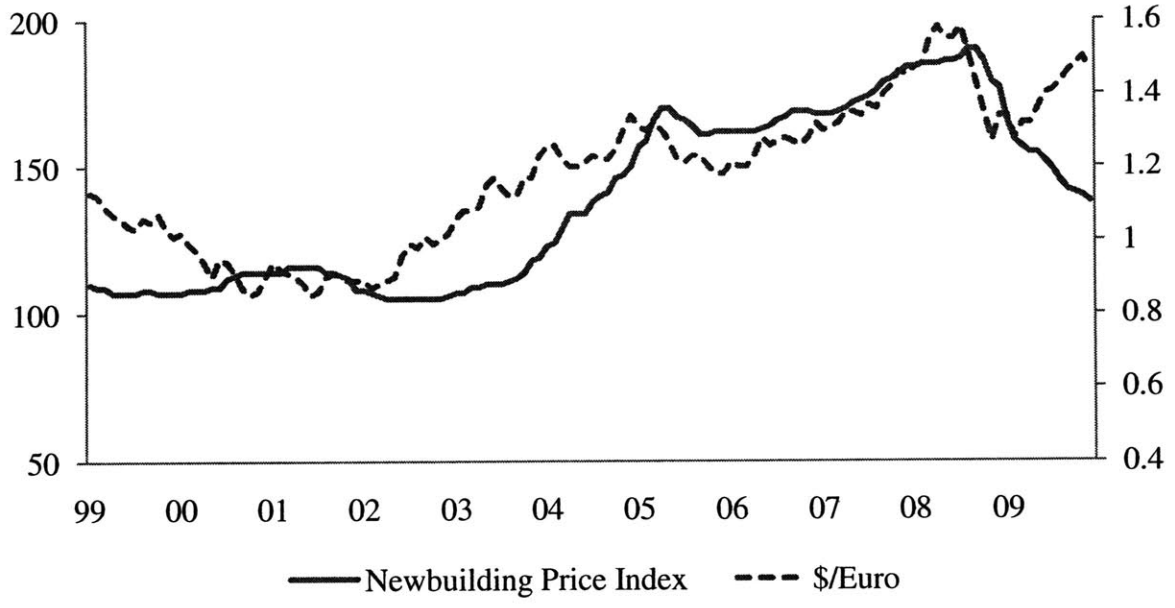

Figure 4.4 Correlation between USD/EURO rate & shipbuilding price index (Source: Clarkson)

Secondly, new orders for offshore units have increased for the previous five years, and it is openly acknowledged that deep-water exploration will increase because of the shrinking of oil reserves in shallow water. Oil prices Offshore units have a different demand factor, (oil prices), compared to other cargos, (the volume of seaborne trade). Oil prices recovered from the bottom, 40 U.S. dollars per barrel, and remain slightly over 80 U.S. dollars per barrel, which means that there is a possibility of increase in new orders of offshore units. As for Korean shipbuilders, if new orders of offshore units increase, it will alleviate over capacity problem to a certain degree.

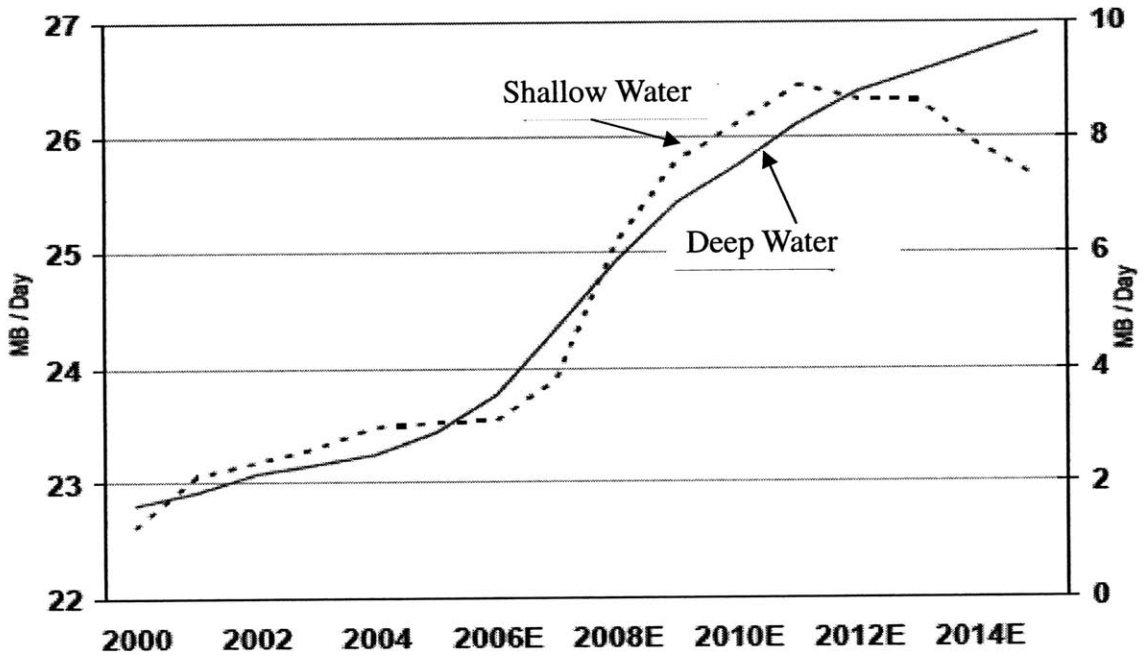

Figure 4.5 Forecast of deep-water exploration (Source: Douglas Westwood)

4.1.2 Supply Perspective

From the shipbuilding supply perspective, the situation can be simply defined as "over capacity". As shown in the table 4.2 below, in order to catch up with dramatic increase in demand, the world leading nations such as Korea and China as well as new developing nations

such as Vietnam, India, and Brazil increased their investments. Because of the unexpected financial crisis, not only the speculative demand but also the real demand declined considerably so that the over capacity problem came to the fore. Until 2011, of course, the major shipbuilders will construct orders received in advance. After that, if the demand does not recover, the world shipbuilding industry will face the risk of falling into a long–term recession.

As mentioned before, the shipbuilding market itself has a high exit barrier due to the substantial exit costs. Worse, because the shipbuilding industry has been regarded as a backbone industry, governments may decide to subsidize shipbuilders that can't sustain themselves, instead of leaving their fate to market mechanisms. Government subsidies may be a major stumbling block for reducing world over capacity.

Table 4.2 World new orders and capacity forecast Unit: Mil. CGT

Category		2007	2008	2009	2010E	2011E	2012E	2013E
New Orders		91.6	47.9	9.8	31.5	31.8	33.4	30.1
Capacity	Total	40.0	45.8	52.3	59.3	63.8	63.5	55.0
	Korea	11.5	14.0	16.0	17.5	19.0	20.0	19.0
	China	6.5	9.0	12.0	16.0	18.5	19.0	18.0
	Japan	10.5	10.5	10.5	10.5	10.5	10.0	8.0
	EU	7.5	7.8	8.5	9.0	9.0	8.0	5.0
	Others	4.0	4.5	5.3	6.3	6.8	6.5	5.0
Over Capacity		-51.6	-2.1	42.5	27.8	32.0	30.1	24.9

Source: Korea Institute for Industrial Economics & Trade, 2008

As we look back at the recent peak in the 1970s, the collapse in demand that stemmed from the oil crisis in 1973 didn't recover for a while, despite the relatively strong GDP growth. It took more than 20 years for the demand to recover to the same level as in 1973. The main reason

was that, despite the strong GDP growth, seaborne trade volume remained stagnant from 1974 to 1989. During this period, CAGR of seaborne trade was only 0.9%. In the 1990s, even though the seaborne trade increased 37%, shipbuilding prices decreased by 31%. The main reason was severe price competition caused by over capacity.

In the previous downturn from 1975 to 2002, strong growth of GDP and seaborne trade with a reduction of shipbuilding capacity was needed to recover the shipbuilding demand and prices at the same time.

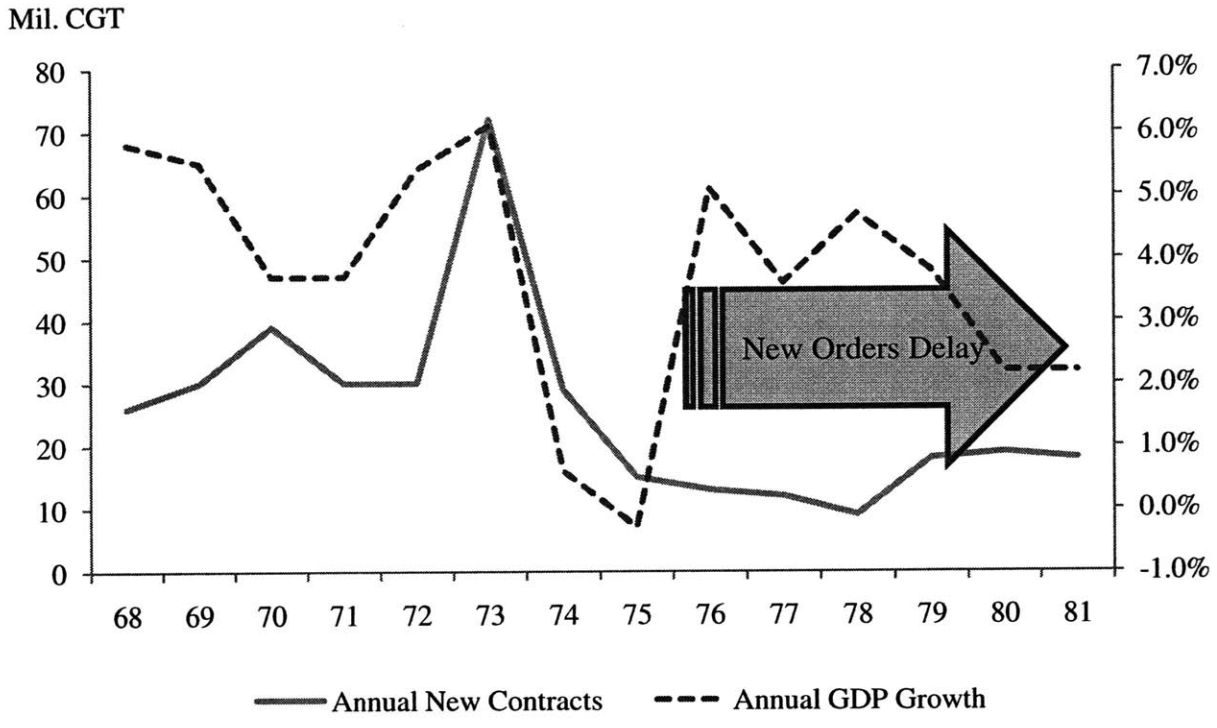

Figure 4.6 Trend of GDP growth and new orders in 1970s
(Source: The Korea Shipbuilders Association, IMF)

4.1.3 Price

Historically, from 1992 to 2002, there was a 36% decrease in the new building price. Compared to that, a 27% decrease during 15 months of downturn was a huge shock to the shipbuilding industry. As shown in figure 4.6 below, all the prices of the main types declined from their peak in 2008.

However, it is noteworthy that LNG carriers' price only dropped by 16% unlike other types of ships that dropped more than 35%. The price of high value added ships declined less than low value added ships such as tankers and bulkers. From the buyers' perspective, they consider quality and delivery more important than cost so that they are less sensitive to the price. From the sellers' perspective, there are a handful of shipbuilders who have enough ability to build high value added products. In other words, these shipbuilders who build high value added ships are price makers rather than price takers to a certain degree.

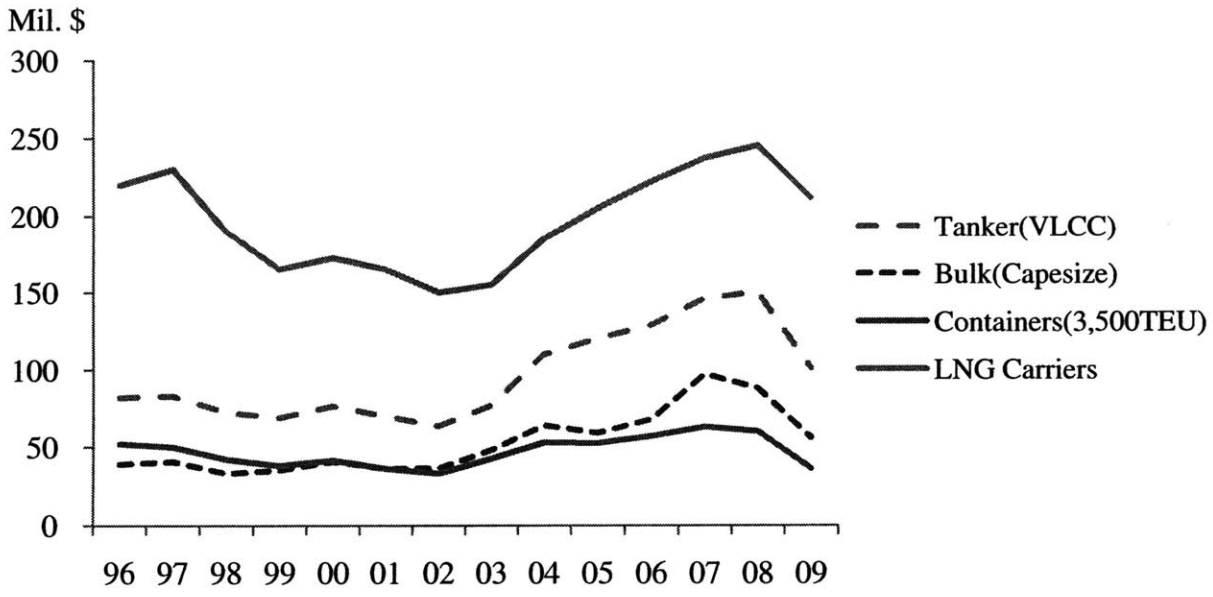

Figure 4.7 New building prices of each ship types (Source: Clarkson)

4.1.4 Other Considerations

The shipbuilding market is getting tougher and tougher largely because of payment delay risks, cancellation risks, change of ship types, and discounts on the contract prices. In fact, cancellation risks are amplified by payment delay risks. Because of payment delay risks, shipbuilders are faced with a shortage of cash, which may lead them to implement marginal business by bidding new orders at discounts to recover from this cash shortage. And then, the discounted building price will accelerate the cancelation of established contracts. The cancellation of established contracts will worsen the over capacity problem while payment delay will exacerbate cash shortage. Since the financial meltdown in 2008, cancellation of container ships reached up to 140 vessels as ship buyers anticipated they would be underutilized. This problem forces the ship buyers to cancel the established contracts rather than suffer underutilization after delivery.

Table 4.3 Cancellations of containers

	China	Germany	Korea	Vietnam	Taiwan	Others	Total
Vessel	43	37	26	14	6	14	140
'000 TEU	111	74	113	14	10	114	436

Source: AXS- Alphaliner

The figure 4.7 below graphically provides the reason why shipping companies cancel their contract with shipbuilders. Container ships in terms of TEU that are not in service have skyrocketed since 2008. The volume, 1.4 million TEU, means 11% of total volume of container fleets.

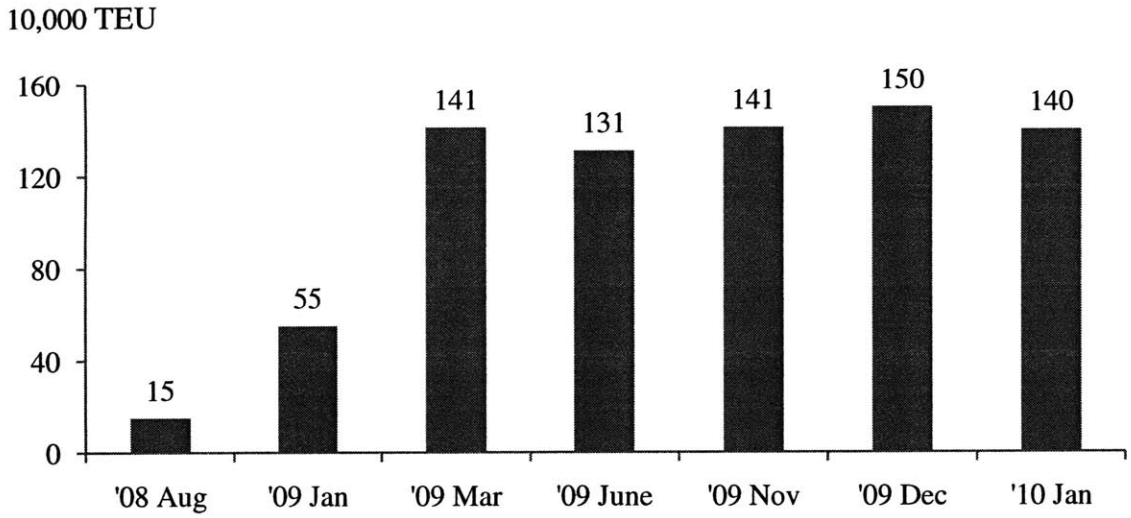

Figure 4.8 Containers not in service (Source: AXS- Alphaliner)

4.2 Market Forecast

The age profiles of main ship types are analyzed as demolition is the only possible way to reduce current over supplied fleets. Annual demolitions are predicted on the premise that all the ships that are above 20 years will be demolished in the coming five years.

Table 4.4 Age profiles of main ship types

	Bulkers(DWT)	Tankers(DWT)	Containers(TEU)	Gas Carriers(CU.M)
Above 20 years	25%	14%	8%	15%

Source: The Shipbuilders' Association of Japan

Note: Single hull tankers are considered as above 20 years, regardless of their age.

Using current market data described above and age profiles of ships, market demand and supply in the coming five years is forecast with several assumptions.

- Target order book/ fleet ratio is 10%, an average of 25 years before recent peak.
- New orders will reach up to the level of 2002, before recent peak.

- Demolitions are estimated on the premise that all the vessels above 20 years will be demolished within five years.
- Current order book will be delivered until 2014 with the delay of initial schedule.
- World seaborne trade is directly proportional to world GDP growth rate.
- Utilization rate of fleets : Current rate*Current average fleets/Current seaborne trade*Estimated seaborne trade/Average estimated fleets
- 10% of new orders awarded in the future will be delivered in two years, 70% in three years, and 20% in four years because of the delay of existing orders.

Table 4.5 Market Forecast Unit: Mil. DWT, Mil. Tons

Year	2008	2009(E)	2010(E)	2011(E)	2012(E)	2013(E)	2014(E)
Beginning Total Fleets	1,132	1,208	1,293	1,379	1,469	1,535	1,601
+Deliveries	90	116	139	130	106	106	117
-Demolitions	14	31	53	40	40	40	40
=Ending Total Fleets	1,208	1,293	1,379	1,469	1,535	1,601	1,678
Beginning Order Book	502	590	515	418	333	280	229
+New Orders	178	41	42	45	53	55	55
-Deliveries	90	116	139	130	106	106	117
=Ending Order Book	590	515	418	333	280	229	167
Order Book/Total Fleets	49%	40%	30%	23%	18%	14%	10%
Utilization Rate of Fleets	87%	80%	76%	76%	76%	76%	76%
World Seaborne Trade	8,170	8,062	8,401	8,761	9,185	9,633	10,091
GDP Growth Rate	3.2%	-1.3%	4.2%	4.3%	4.8%	4.9%	4.8%

Source: Author based on the data of IMF and Review of Maritime Transport

As shown in table 4.5 above, the order book/total fleets ratio will decrease from 49% to 10% in 2014. Annual completions of shipbuilders will be slightly above 100 million DWT, which will not cause a serious over capacity problem.

From the ship buyers' perspective, the problem is that total fleets will reach up to 1,678 million DWT, and consequently result in low utilization rate. The utilization rate of 76% is 4% less than utilization in 2009. With this low utilization rate, there is no reason for ship buyers to place new orders more than the level of 2002.

Even if they place new orders for speculative purposes stemming from anticipated appreciation of the Euro and declining ship prices, new ship building price will not rebound because of over capacity. As mentioned above, in the 1990s, over capacity caused serious price competition among shipbuilders, and therefore the shipbuilding price decreased by 36%.

From the shipbuilders' perspective, a sharp drop in new orders, order book, and shipbuilding prices will mean a cash deficit caused by decreases in net advance receipts. Also, shipbuilders will experience decrease in profitability because of low shipbuilding prices and increase in average cost per output. Worse, after 2014, annual deliveries will decline sharply because of the decreased order book level, which means that the over capacity problem will eventually come to the fore.

4.3 Summary

Even though the market forecast projected above is based on a back-of-envelope calculation, it provides several implications for Korean shipbuilders. From the demand perspective, shipbuilders cannot expect a substantial increase in demand as seen in the previous peak because the substitution demand is in the final stage and the order book/current fleet ratio is

too high compared to the historical average. In this sense, the pre-condition for an eventual recovery from downturn is strong GDP growth followed by increase in seaborne trade. In addition, there is a possibility of an increase in demand driven by appreciation of Euro, decreased shipbuilding prices, and offshore units.

From the supply perspective, Korean shipbuilders should cease capacity expansion so as not to suffer from a decline of shipbuilding prices. At the same time, Korean shipbuilders should focus on high value added ships to avoid severe price competition.

This market analysis is critical because Korean shipbuilders' performance will highly depend upon the period of downturn.

Chapter 5 Current Status of Korean Shipbuilding Industry

In this chapter, I will focus on the current status of Korean shipbuilders in terms of market share, order book, and workforce. In addition, I will compare their competitive advantages with those of Japanese and Chinese shipbuilders to suggest where the business opportunity lies for Korean shipbuilders. Lastly, I will explain the reason why the Korean shipbuilders' order book has registered a dramatic increase in offshore units.

In Korea, shipbuilding industry has a very huge effect on employment and in the upstream and downstream industry. Also, the shipbuilding industry became the number one industry in terms of exports, surpassing the semiconductor industry and the automobile industry in 2008. As presented in table 5.1 below, the total exports of the shipbuilding industry reached up to 12.4% of total Korean exports. In 2009, the total exports decreased at 16%, whereas exports of shipbuilding increased slightly.

Table 5.1 Portion of Korean shipbuilding in terms of exports Unit: Billion $

Item	2005	2006	2007	2008	2009
Shipbuilding (Percentage)	17.7 (6.2%)	22.1 (6.8%)	27.7 (7.5%)	43.1 (10.2%)	45.1[24] (12.4%)
Exports	284.4	325.5	371.5	422.4	363.8

Source: The Korea International Trade Association

[24] Even though the total export amount decreased by 13.8%, export amount in shipbuilding industry increased by 4.6%. This result is not because the shipbuilding industry is still in boom but because the order won from 2007 to 2008 is delivered.

5.1 Market Share

The world merchant shipbuilding market is dominated by Korean shipbuilders in terms of top builders, new orders, and completions. In 2009, Korea still kept the lead position in the shipbuilding industry in terms of new orders and completions. With regard to order book, China took the leading position away from Korea by increasing market share in bulk carriers.

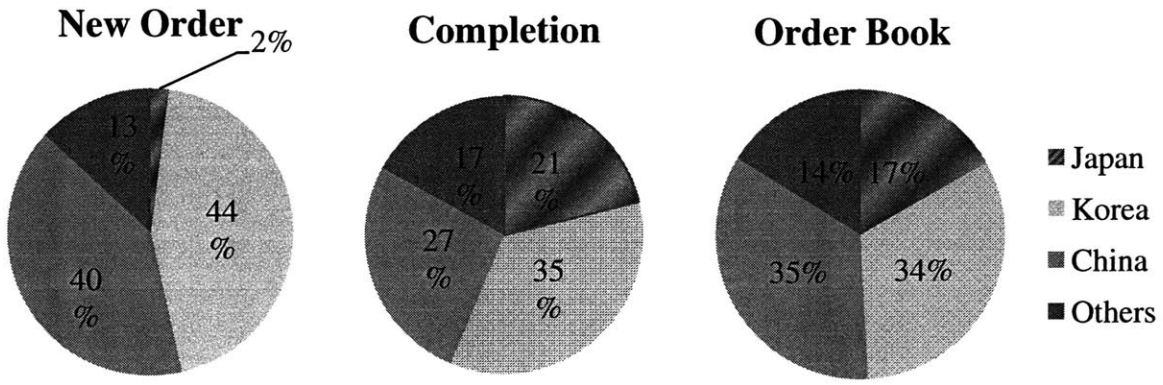

Figure 5.1 Relative market shares as of 2009 (Source: The Shipbuilders' Association of Japan)

5.2 Order Book

After Korea took a market lead position, Korean shipbuilders tried to diversify their product mix and concentrate on high value added ships by participating in bids selectively considering their hurdle rate and product mix. As I described briefly in Chapter 2, table 5.2 below shows that Korea is still holding the market lead in relatively sophisticated ship types such as large containers, gas carriers, and offshore units. Until now, it is apparent that China lacks a presence in the premium product category.

Table 5.2 Order book mix of China and Korea in 2009 Unit: '000 CGT

Country	Bulkers	Tankers	Containers	Gas Carriers
S. Korea	12	17	17	4
China	30	10	6	0.2

Source: Clarkson

Note: Gas carriers are measured by DWT.

At the end of 2009, Korean big players' order book ranged from 2.2 years to 3.3 years, which means they can endure at least 2 years without additional new orders. This assumption is based on a calculation dividing the order book as of 2009 with implied capacity. They still seem to have sufficient orders in their order book. However, since the order book includes the workloads that are completed but not delivered[25], actual remaining workloads are far less than estimates in table 5.3 below.

Table 5.3 Current order book and capacity Unit: Mil. CGT

Country	World Rank	Company	Implied Capacity	2009 Deliveries	Order Book	Order Book/ Capacity
Japan			9.8	9.3	23.2	2.4
China			14.0	11.7	53.2	3.8
Korea			16.0	15.4	52.8	3.4
	1	Hyundai	3.9	3.6	8.4	2.2
	2	Samsung	2.5	2.4	8.4	3.3
	3	Daewoo	3.0	3.0	8.2	2.7
	4	STX	1.1	1.0	4.7	4.1

Source: Clarkson

Note: Implied capacity is assumed as the greater of the historical maximum completion amount since 2000 and the expected completion amount in 2010.

[25] The order book numbers reflect ships that have been ordered, but not delivered.

In addition, because of a collapse of new orders, Korean shipbuilders' order book is declining continuously; therefore they are suffering from cash shortage, facing a so-called liquidity crisis. No orders mean no advance receipts, which in turn will deplete cash reserves quickly. Furthermore, considering the typical installments of ship contracts, shipbuilders receive payment in advance and spend most of the construction costs later. If new orders stop, shipbuilders' cash inflow will decrease. On the other hand, their cash outflow will increase by new orders awarded in advance. In this respect, if the recession doesn't rebound quickly, several Korean shipbuilders who can't raise funds through capital market will be squeezed out from the shipbuilding market. I will analyze the financial structure of Korean shipbuilders in Chapter 6.

5.3 Workforce

The employees in the shipbuilding industry have increased in response to the changes in annual production level. As shown in figure 5.2 below, the number of employees of the nine major Korean shipbuilders has gone up to 101,632 at 8.5% CAGR. If small and medium sized shipbuilders' and equipment suppliers' employees are included, the total number of employees who are working in shipbuilding industry will be more than twice of the figure below.

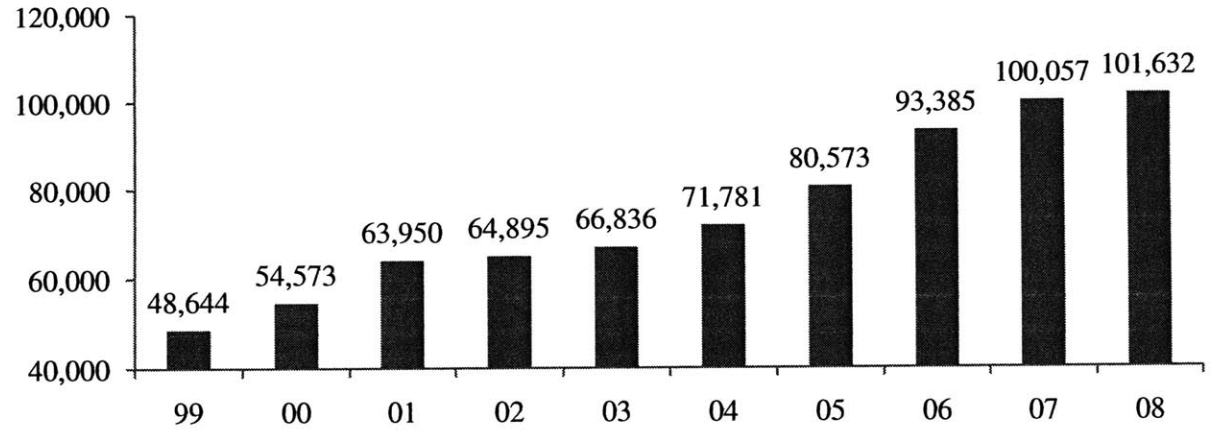

Figure 5.2 Employees in nine major Korean shipbuilders (Source: KOSHIPA)

On close examination, the overall composition of employees can be broken into design, production, management, and outsourcing part. As shown in figure 5.3 below, design employees consist of approximately 10% of total employees and indirect employees who are working at management, sales, and procurement department decreased from 8% to 4%. The reduced proportion of indirect employees can be explained by economies of scale in an organization and enhancement of management system. In addition, production workers including outsourced workers have increased from 80% to 84%. However, the composition of production workers has changed totally and, as a result, the portion of outsourced workers increased from 26% to 55%.

This was the outcome of Korean shipbuilders' efforts to raise flexibility in the production workforce and to reduce labor costs. Considering the fluctuation in the shipbuilding industry and the rigid labor market, it must have been a burden for Korean shipbuilders to increase internal production workers.

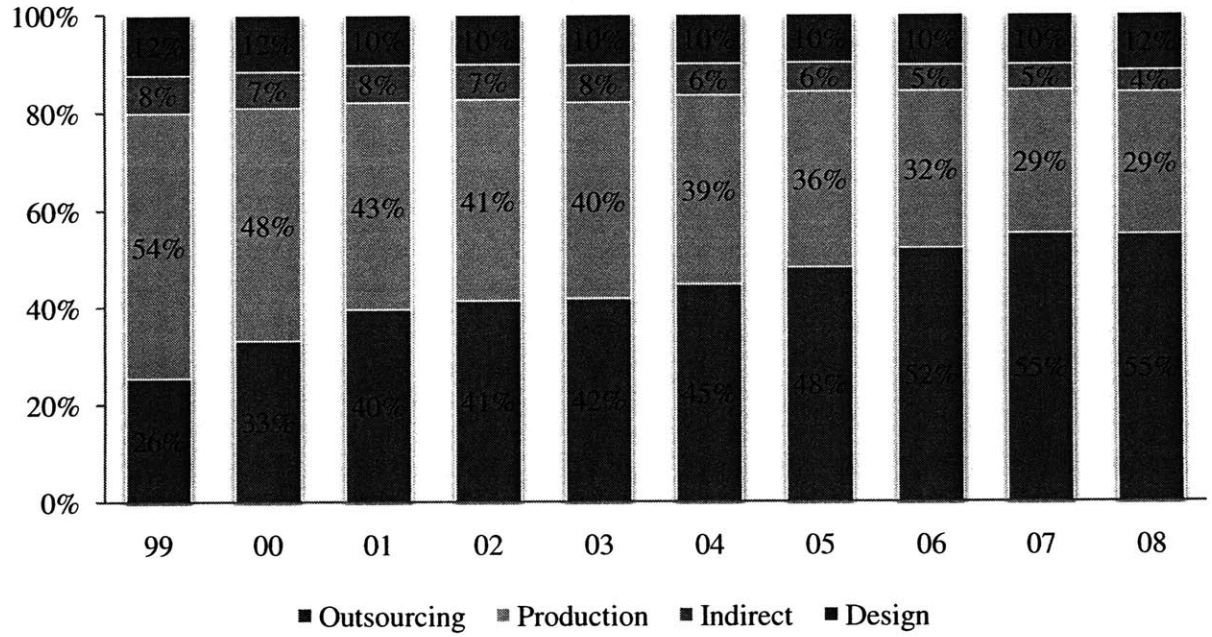

Figure 5.3 Composition of employees (Source: The Korean Shipbuilding Association)

Over six years, the average salary of employees in shipbuilding companies has increased at a 7.8% CAGR; the average sales revenue per person in shipbuilding companies has increased at a 15.4% CAGR. This means that the portion of labor costs out of sales has decreased. However, 15.4% annual increase of sales per employee doesn't simply indicate a huge productivity improvement because the increased outsourced employees are not counted.

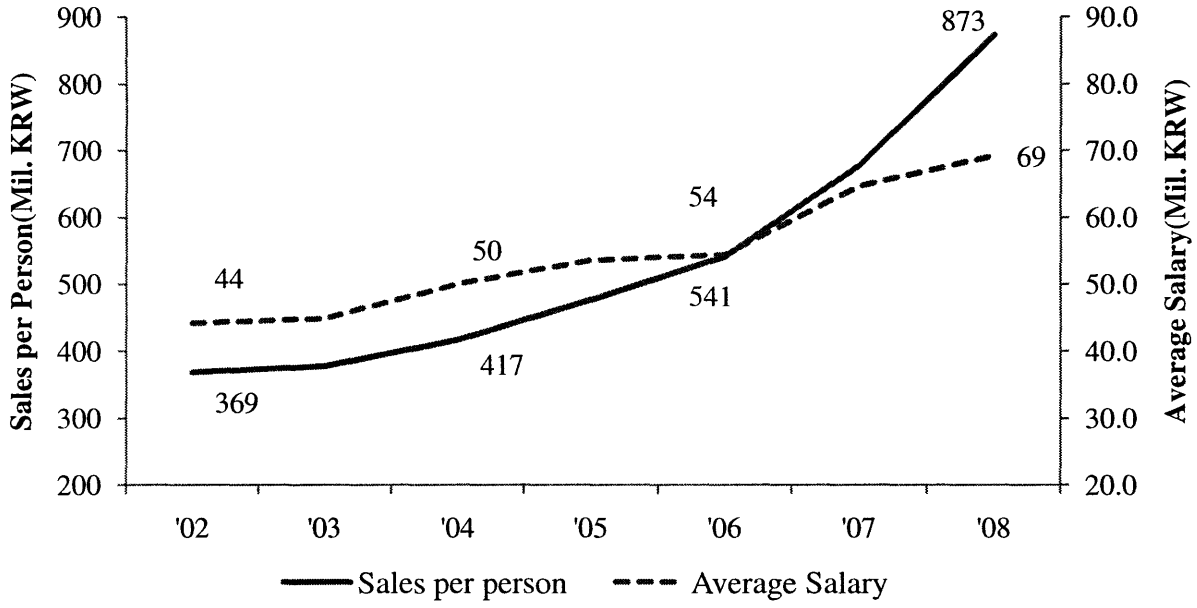

Figure 5.4 Average salary & sales per employee (Source: Annual Reports)
Note: The average of major four companies (HHI, SHI, DSME, STX)

Because of abundant cheap workforce, China has a competitive advantage in labor costs. As shown in table 5.4 below, for Korean shipbuilders, 24% of total manufacturing costs are labor costs; while it is only 15% for Chinese shipbuilders. Typically, labor productivity is measured by output per labor hour. However, considering the difference in wages between Korea and China, labor productivity should be compared in terms of output per wage. In this regard, Korean shipbuilders still spend 45% more on labor costs in building mid-sized bulk carriers. This is why Korean shipbuilders are losing their presence in the bulk carrier market. Also, strategically, this

table illustrates that there is no reason for big Korean shipbuilders to stay in the bulk carrier market except for implementing marginal business to fill in the plant.

Table 5.4 Comparison of labor costs between Korea and China

		Korea (A)	China (B)	(A-B)/B
% of Labor Costs in Cost Structure		24%	15%	60%
Panamax Bulk Carrier[26]	Labor Costs (Mil. $)	24.2	16.7	45%
	Labor Hours ('000)	278	334	-17%
	Wage ($/Hour)	87	50	74%

Source: The Korean Shipbuilding Association, J.P. Morgan

5.4 Competitive Advantages

As shown in table 5.5 below, when it comes to the competitive advantages among Korea, Japan, and China, Japan is superior to Korea in terms of financing support and downstream industry. However, Korean shipbuilders surpass Japanese shipbuilders in terms of the skill of production and design workforce, overall system, and low labor costs. Korean shipbuilders are superior to Chinese shipbuilders regarding all the factors except for cost factors.

Overcoming disadvantages, while maintaining competitive advantages, are definitely critical for superior performance among competitors. In this shipbuilding downturn that is expected to linger, indirect support from the domestic shipping industry and financing institutions are more critical to sustain the industry. As mentioned in Chapter 3, a strong domestic shipping industry and recovery of ship finance is important factors for increase in demand. However, without the government support and willingness of shipping companies and financial institutions, for shipbuilders, it is not easy to be benefited from these industries.

[26] Panamax ships are the largest ships that can pass through Panama Canal. The size in DWT ranges from 60,000 to 80,000.

Table 5.5 Comparison of competitiveness among Korea, Japan, and China

Category		Japan	Korea			China		
			2007	2010	2015	2007	2010	2015
Cost	Materials	100	100	100	100	106	102	101
	Wages	100	106	102	99	143	135	125
	Others	100	102	100	99	122	115	109
Non-Price	Quality	100	100	101	103	76	80	88
	Performance	100	101	102	104	83	86	90
	Delivery	100	100	100	100	83	86	90
	Financing	100	94	97	99	78	84	89
	Credibility	100	100	101	103	74	79	85
Workforce	Average Age	100	107	105	105	116	114	111
	Production	100	106	106	106	95	97	101
	Design	100	110	111	112	79	85	90
Productivity		100	95	97	101	69	74	92
System		100	104	105	108	71	78	84
Related Business	Shipping	100	83	85	88	86	88	93
	Supply Chain	100	96	98	101	74	78	86
Total		100	100	100	101	88	91	94

Source: Korea Institute for Industrial Economics & Trade, 2007

Note: In each year, Japan is a standard among three countries and 100 points is assigned. Each point is estimated based on the relative strength. The factors that are superior to those of Japan are estimated over 100 points.

5.5 Offshore Plant Business

Since 2000, major shipbuilders in Korea have been awarded orders of offshore plants. Even though drill-ships, FPSOs, and FSRUs are categorized as offshore units, they are basically ship-shape vessels, which means that hulls are built by shipbuilding division and topsides by offshore division. For these ship-shape vessels, Korean shipbuilders who have superior production and design technologies are the only choice for oil majors to place new orders with. For oil majors, building hull and topside at different yards is time consuming and inefficient.

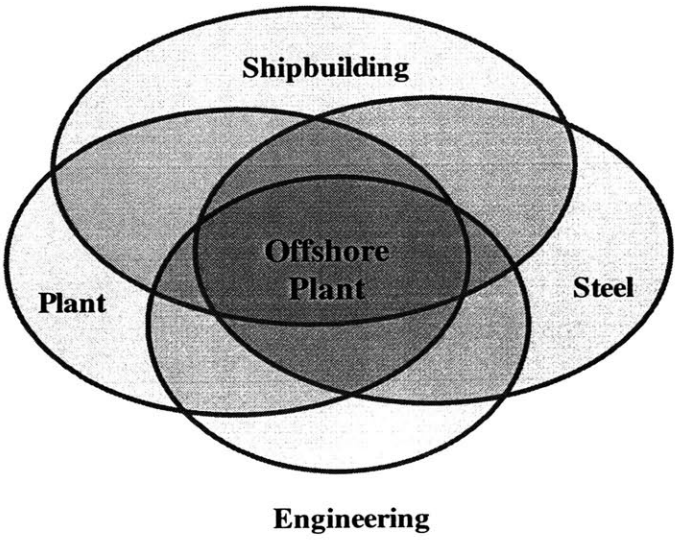

Figure 5.5 Relevant industries with offshore plant (Source: Hong 2006)

Because of oil price increases and a demand for deep-water oil exploration, major Korean shipbuilders had dramatic increases in the portion of offshore units in order book mix. For instance, in the case of SHI, 51% of order book in dollars is offshore units and 32% of total sales in 2008 came from offshore units. Contrary to this, the portion of offshore units in terms of gross

tons is only 8%. The fact that the contract price of a drillship is over 600 million dollars[27], which is 3 times more than that of a LNG carrier, explains the difference between sales portion and order book portion.

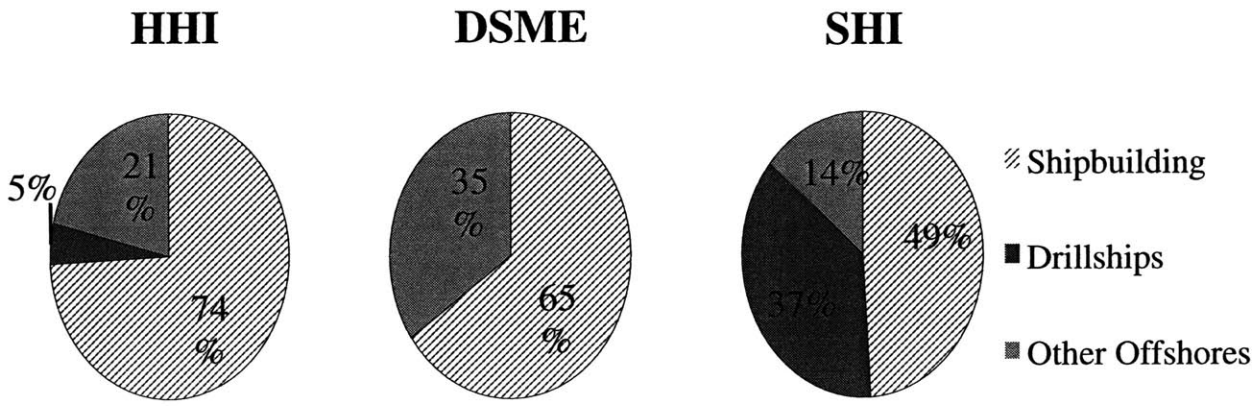

Figure 5.6 Order book mix in dollars (Source: IR reports)

Note: Total is the sum of shipbuilding and offshore division. DSME's other offshore portion includes drillship order book.

5.6 Summary

Until now, Korean shipbuilders kept their lead position in the market and they tried to diversify their product mix and concentrate on high value added ships. They still seem to have sufficient orders in their order books ranging from 2 to 3 years. However, their order book may decrease significantly because of the collapse in demand.

With regard to workforce, the number of employees in the shipbuilding industry has increased more than two times during the previous ten years. At the same time, the portion of outsourced workers increased from 26% to 55% making it easy for Korean shipbuilders to manage flexibility in workforce and to lower the labor costs.

[27] The contract prices are based on shipbuilding companies' public announcement in 2008.

However, the average salary of employees has increased significantly, and therefore Korean shipbuilders seem to have lost their strong presence in simpler ships. In this regard, an inescapable fact that Korean shipbuilders are confronted with is constant increase of labor costs, and thus the loss of cost leadership that is driven by low wages. Considering that the leadership in the shipbuilding industry has evolved with time and given the current level of Korean shipbuilders' and the growth of labor costs, the disparity of average salary per Korean shipbuilding employee and Chinese shipbuilding employee will increase. To offset the disadvantage of high labor costs, Korean shipbuilders should maintain and improve competitive advantages in non-price factors and focus on high value added ships.

Chapter 6 Financial Analysis of Korean Big Players

In addition to the industry and market analysis, in this chapter, financial data of Korean big players will be analyzed in depth in order to understand more concisely the underlying economics of the shipbuilding business. The financial statements of the four big Korean players will be used as a touchstone for understanding the business characteristics and the current market situation mentioned in the previous chapters. Also, the financial analysis will shed light on feasible strategies that Korean shipbuilders can implement to sustain themselves in this market downturn and, at the same time, will suggest ways in which they can pay attention to potential financial risks.

6.1 Sales Revenue

Over the previous five years, major Korean shipbuilders' sales[28] increased at a 17% CAGR in dollar basis, a feat that is very rare in large companies. Considering the fact that the average won-dollar exchange rate in 2005, 1024.1Won/$, depreciated by 25% in 2010, to 1276.4Won/$, the sales in Korean won increased at 24% CAGR during the same period. Since shipbuilding projects need more than 2 years to complete, the major portion of sales in 2009 is generated from the orders received in 2007. The fact that Korean shipbuilders generally hedge currency risks by forward contract and the average won-dollar exchange rate in 2007 was only

[28] Korean shipbuilders recognize revenues and gross profits before completion and delivery based on the progress of the construction by the percentage-of-completion method. To use the percentage-of-completion method, below conditions are satisfied.

- Total costs and revenues can be reasonably estimated.
- The contract should identify enforceable rights.
- Both participants of contract are expected to follow the contractual obligations.

Percentage completed is measured by dividing costs incurred to date with estimated total costs.

929.2Won/$ implies that the actual sales increase was even greater than 24% CAGR.

HHI, the world's number one shipbuilder, grew only at 13% CAGR which is less than second tier companies' CAGR. This means that, for instance, STX invested more aggressively than HHI to catch up with the recent peak. On the flip side, the more the companies have invested, the more they will suffer from financial risks during an expected long term recession. Further explanation about the financial risks will be provided in detail with debt to equity ratio.

Table 6.1 Sales Revenue Unit: Mil. $

Sales	2005	2006	%	2007	%	2008	%	2009	%	CAGR
HHI	10,111	13,139	30	16,717	27	18,100	8	16,564	-8	13
SHI	5,416	6,647	23	9,168	38	9,672	5	10,259	6	17
DSME	4,603	5,652	23	7,646	35	10,044	31	9,748	-3	21
STX	1,121	1,716	53	2,291	34	2,726	19	3,284	20	31
Total	21,251	27,154	28	35,822	32	40,543	13	39,855	-2	17
KRW	21,763	25,946	19	33,286	28	44,702	34	50,871	14	24

Source: Annual reports of four companies from 2005 to 2009

Note: Annual sales are converted by the average annual exchange rate against U.S. dollars.

As mentioned in the previous chapter, shipbuilding companies' profits fluctuated highly based on external factors, which meant that the portfolio mixes of shipbuilders were critical. The business area of HHI encompasses diverse industries including shipbuilding, engines, plants, construction equipments, and electrical systems within a single entity. As shown in figure 6.1 below, HHI's portfolio mix consists of both related business such as engine and machinery and

unrelated businesses such as electric system and construction equipment with shipbuilding business. In addition, HHI entered into new energy businesses such as solar power market by having vertically integrated value chain and wind turbine market by consortiums.

However, the second tier companies such as SHI and STX are subsidiaries of Samsung Group and STX Group, respectively. STX have same business portfolio as HHI in terms of affiliates and subsidiaries under a holding company.

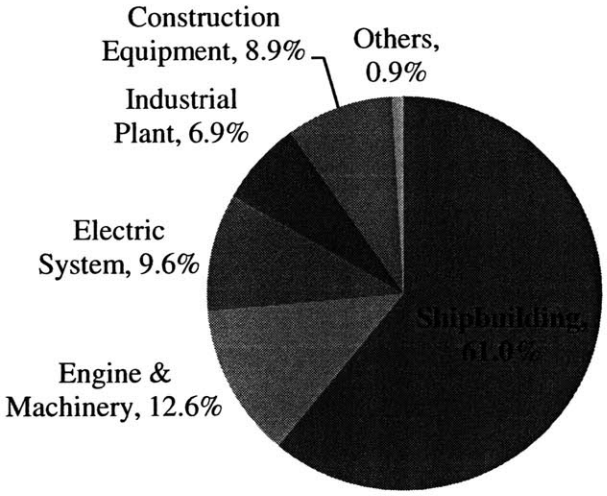

Figure 6.1 Sales mix of HHI (Source: Annual Reports as of 2008)
Note: Shipbuilding division includes offshore division.

6.2 Operating Profit & Margin

As shown in table 6.2 below, with regard to operating profit and margin, several trends can be recognized. First, the four companies' operating profits and margins have increased dramatically. Second, the more market share the company had, the more operating margin it generated. HHI's operating margin in 2009 was 11%; STX's was 2%. Third, despite low steel

prices and increases in sales, the average operating margin started to decline from 9% in 2008 to 7% in 2009. The decrease of operating margin could be partly explained by the appreciation of the won-dollar exchange rates in 2007.

Table 6.2 Operating profit & margin Unit: Mil. $

Sales	2005	%	2006	%	2007	%	2008	%	2009	%
HHI	89	1%	920	7%	1,884	11%	2,001	11%	1,741	11%
SHI	-4	0%	60	1%	431	5%	685	7%	622	6%
DSME	-121	-3%	-177	-3%	330	4%	936	9%	536	6%
STX	-157	-14%	17	1%	102	5%	86	3%	77	2%
Total	-194	-1%	820	3%	2,747	8%	3,707	9%	2,976	7%

Source: Annual Reports

A closer look at the operating profit of HHI shows that, other than economies of scale, there was other reason for a high operating margin. As mentioned above, HHI had shipbuilding related and unrelated businesses. The Engine & Machinery division, for instance, mainly manufactured marine engines and its internal transactions amounted to 858 million dollars in 2008. Moreover, engine division's operating margin was 23% in 2008, which meant HHI could reduce the cost of engine by 23% compared to other competitors who purchased marine engines from suppliers or other affiliates. According to back- of- envelope calculations, the cost saving was 197 million dollars[29], which accounted for 9.8% of operating profit and 1.1% operating margin.

[29] The amount of internal transaction * division's operating margin: 858 million * 23%

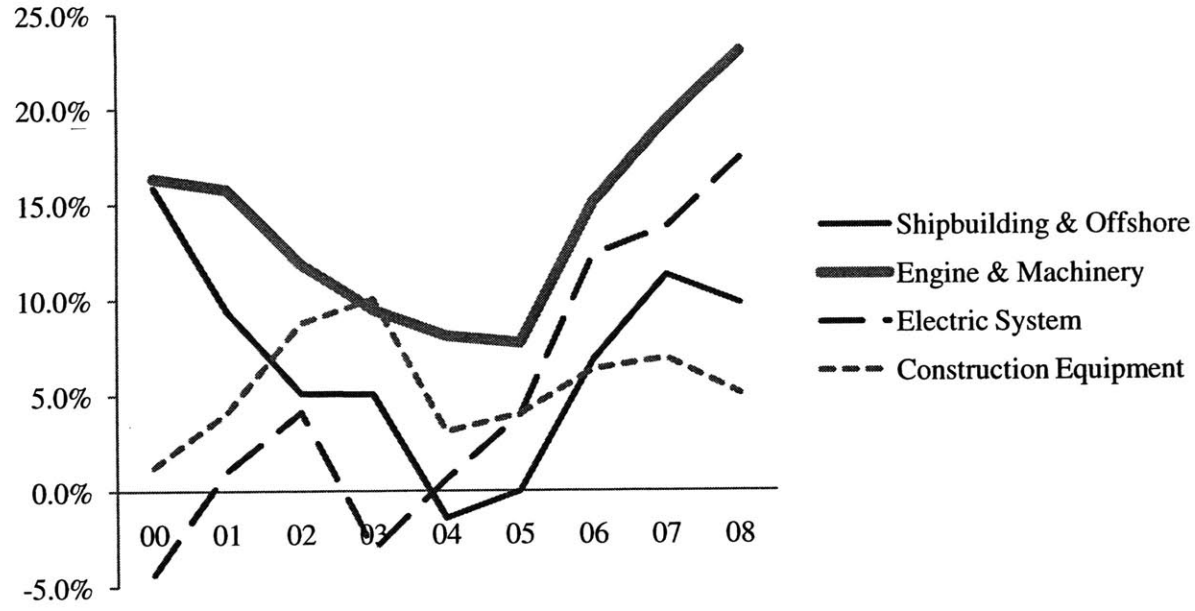

Figure 6.2 Operating margins of HHI divisions (Source: Audit reports of 2000~2008)
Note: Headquarters' SG&A is allocated to each division by sales.

6.3 Interest Income

According to a traditional shipbuilding contract, shipbuilders receive 40% of contract price before starting production. These advance receipts enabled companies to invest in financial instruments which generated interest income. In case of SHI and DSME, the major portions of sales are generated from shipbuilding business so that their interest income was more than 30% of their net income.

In 2009, however, four companies, without exception, started to issue corporate bonds or to borrow money from banks, which caused a dramatic increase in interest expenses. As I previously mentioned, there were two main reasons for cash shortage: delay of payments of established orders and no additional orders. The phenomenon of the cash shortage appeared not only in interest expenses, but also in other financial accounts such as interest bearing debts, operating cash flow, and net advance receipts.

Table 6.3 Interest income Unit: Mil. $

Company		2005	2006	2007	2008	2009
HHI	Interest Income	94	94	215	254	131
	Interest Expense	-25	-11	-12	-6	-27
	Net Interest Income	69	83	203	248	104
	% of Net Income	39%	11%	11%	12%	6%
SHI	Interest Income	64	87	155	195	98
	Interest Expense	-4	-2	-7	-6	-52
	Net Interest Income	60	85	148	189	46
	% of Net Income	82%	53%	28%	33%	9%
DSME	Interest Income	39	65	112	147	51
	Interest Expense	-22	-31	-22	-13	-51
	Net Interest Income	17	34	90	134	0
	% of Net Income	243%	56%	26%	37%	-
STX	Interest Income	4	7	31	60	78
	Interest Expense	-16	-16	-12	-15	-65
	Net Interest Income	-12	-9	19	45	17
	% of Net Income	200%	-21%	11%	115%	718%

Source: Annual Reports

As shown in figure 6.3 below, in 2007, the interest income of four companies was enough to offset other non operating expenses and even increased net income before taxes. For shipbuilders, the effect of the time value of the money is huge because of the long term characteristics of the industry and expensive contract price. In this regard, when shipbuilders determine a contract price and a payment method before bidding, they should analyze interest rate differentials between two countries and differences between deposit rate and loan rate. Both a shipbuilder and a ship buyer can have an arbitrage profit by negotiating the contract price and the payments method.

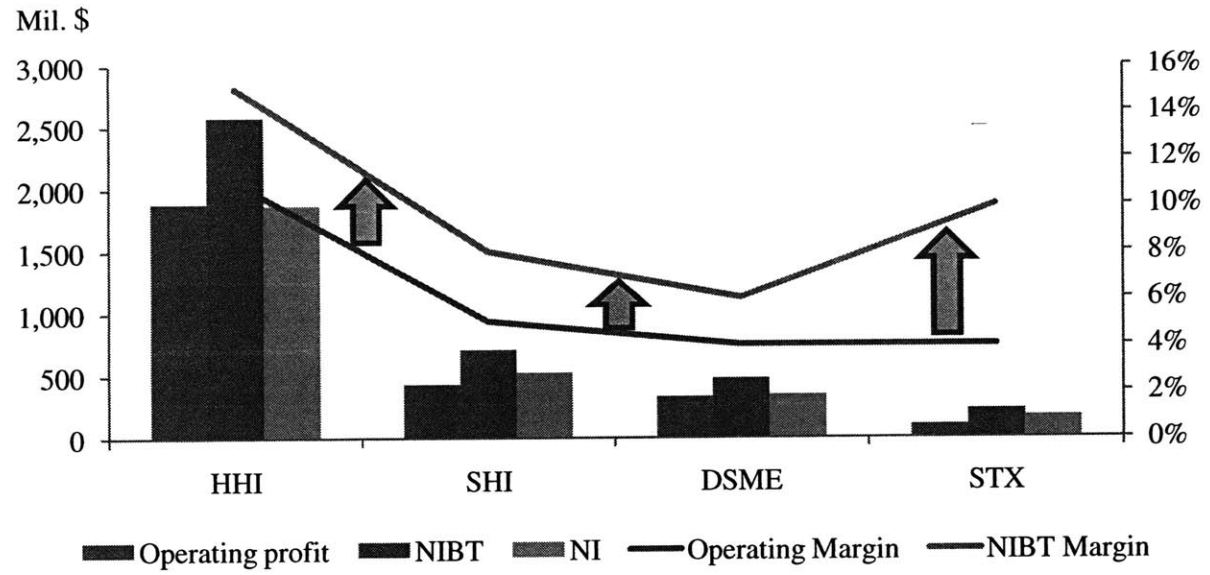

Figure 6.3 Effect of interest income (Source: Annual Reports as of 2007)

6.4 Advance Receipts

Net advance receipts (Advance receipts less Accounts receivables) means cash amount received in advance that isn't recognized as sales. Considering the matching principle in accounting, most of the net advance receipts are not free cash but cash that has to be used for manufacturing costs. In 2009, net advance receipts decreased significantly as a result of the decrease in advance receipts and the increase in accounts receivables.

As shown in table 6.4 below, STX experienced a lower decline of net advance receipts than other companies. In case of STX, CAGR of 24% is highly correlated with new orders received in 2009, accounting for 39% of new orders of four companies, which resulted in 4 years of work load.

Table 6.4 Net advance receipts Unit: Mil. $

Net Advance Receipts	2005	2006	%	2007	%	2008	%	2009	%	CAGR
HHI	3,153	3,861	22%	5,571	44%	5,075	-9%	2,788	-45%	-3%
SHI	2,346	4,162	77%	5,828	40%	6,035	4%	1,463	-76%	-11%
DSME	942	1,832	94%	3,198	75%	2,032	-36%	465	-77%	-16%
STX	426	788	85%	1,766	124%	2,134	21%	1,008	-53%	24%

Source: Annual Reports

Note: Net Advance Receipts: Advance Receipts - Accounts Receivables

Even though recognition of sales revenue of a project is different from the cash out-flow, as a rule of thumb, the figure 6.4 below provides a timeframe when payments are received, manufacturing costs are incurred, and accounts receivables increase. After starting steel cutting, shipbuilders confront with a decrease in net advance receipts, and therefore experience cash deficit. The balance of cash deficit is recovered only when delivery is completed.

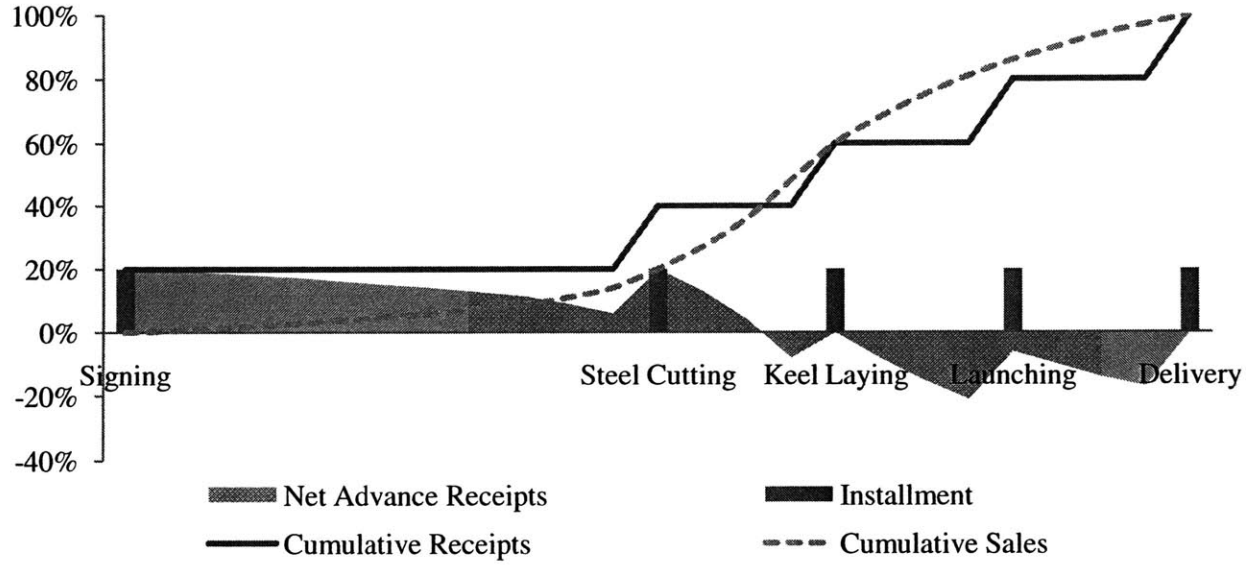

Figure 6.4 Time chart of a project's net advance receipts (Source: Author)

Note: The accumulation of manufacturing costs is assumed to be s-shaped curve.

As a result, in 2009, four companies experienced a huge increase in interest bearing debt to equity ratio. Debt to equity ratio of SHI, for instance, increased from 0.07 to 0.72 in 2009. Worse, mid-sized shipbuilders are suffering more from cash deficit and even several shipyards became insolvent. For instance, in Korea, credits of seven shipbuilders have been rated under investment grade; in Japan, two shipbuilders declared insolvency.

Table 6.5 Debt to Equity Ratio

Company	2005	2006	2007	2008	2009	CAGR
HHI	0.06	0.04	0.03	0.00	0.10	16%
SHI	0.04	0.06	0.07	0.07	0.98	117%
DSME	0.32	0.20	0.17	0.14	0.89	29%
STX	0.76	0.34	0.20	0.43	2.46	34%

Source: Annual Reports

Note: Debt (Interest bearing debt), Equity (Excluded unrealized gain on revaluation of PP&E)

6.5 Property, Plant & Equipment

Property, Plant, and Equipment (PP&E) represent the productive assets under management control to operate businesses. Over the past five years, each firm's net PP&E in KRW has increased at over 10% CAGR. In case of STX, considering the 31% CAGR in sales, 15% growth of investment was inevitable.

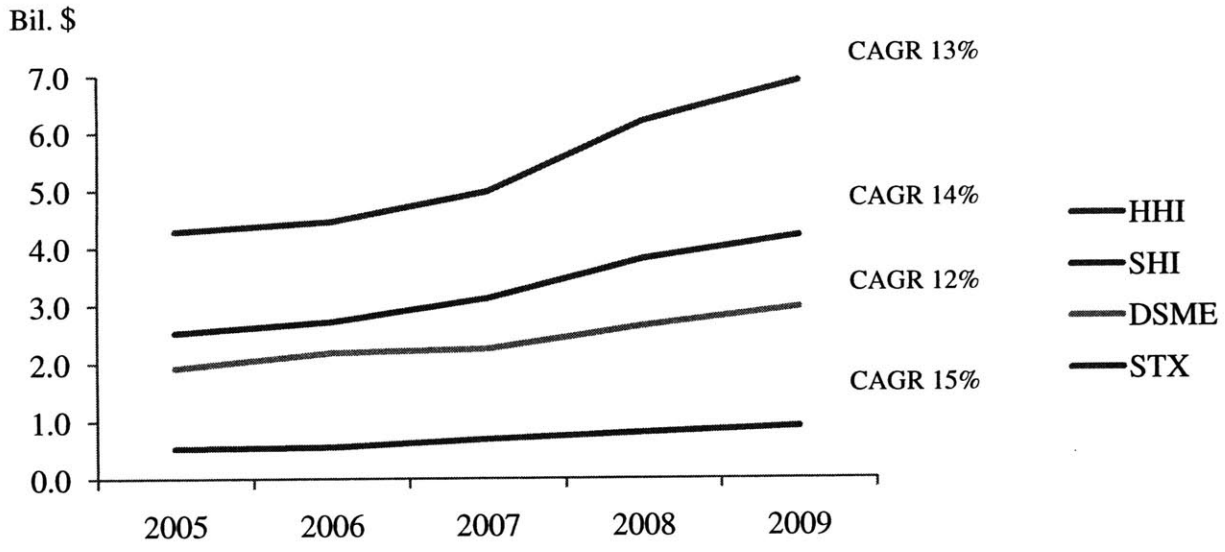

Figure 6.5 Net PP&E (Source: Annual Report)

Note: 1,000 KRW/USD, Excluded PP&E increased by revaluation in 2009

Another reason for the decrease of the percentage of net PP&E was economies of scale that could be observed by PP&E turnover. As shown in table 6.6 below, SHI and DSME has increased PP&E turnover[30] at 10% CAGR and 19% CAGR, respectively.

Table 6.6 PP&E turnover

Company	2006	2007	2008	2009	CAGR
HHI	2.9	3.3	3.6	3.2	4%
SHI	2.4	2.9	3.1	3.3	10%
DSME	2.6	3.2	4.5	4.4	19%
STX	3.0	3.4	3.9	4.7	16%

Source: Annual Report

Note: 1,000 KRW/USD, Excluded PP&E increased by revaluation in 2009

[30] Net Sales/Average of Net Property, Plant, and Equipment

It can be easily inferred that depreciation expense will increase in response to the increase of PP&E. Since depreciation expense is one of the major fixed costs, average costs per output will increase drastically if shipbuilders can't fill in the plant. Therefore, I forecast annual depreciation expenses based on several assumptions.

- Annual capital expenditures for replacement are assumed as 60% of 2009 expenses.
- Useful life is calculated based on historical data.

  (Average depreciable PPE/ Depreciation Expense)
- Excluded land from depreciable assets.
- When each investment is completed, the depreciation expense incurs only 50% of annual depreciation expense at the first year.

Table 6.7 Depreciation expenses forecast Unit: Mil. $

		Actual			Forecast				
		2007	2008	2009	2010(E)	2011(E)	2012(E)	2013(E)	2014(E)
HHI	CAPEX	752	1,471	1,000	600	600	600	600	600
	Depreciation	352	347	400	466	517	567	617	667
SHI	CAPEX	582	893	621	373	373	373	373	373
	Depreciation	216	238	263	296	325	355	384	414
DSME	CAPEX	171	485	460	276	276	276	276	276
	Depreciation	133	136	153	179	199	218	238	257
STX	CAPEX	171	574	111	89	89	89	89	89
	Depreciation	34	36	46	50	55	61	67	72

Source: Author

Profitability of the four companies will deteriorate by substantial increase in depreciation expense. Their depreciation expenses are expected to increase approximately at 10% CAGR.

However, because of tax shield, increased depreciation expense will generate positive operating cash flow.

6.6 Operating Cash Flow

A close examination of cash flow statement of four shipbuilders provides evidence of what the main streams of cash flow are. Because of strong operating cash inflow stemming from high net income, they could invest in productive assets and financial instruments, or repay borrowings. However, in 2009, regardless of positive net income, increase in accounts receivable and decrease in advance receipts caused substantial operating cash outflow. The reaction of the four companies' to cover cash deficit was to borrow from banks and to issue bonds.

Table 6.8 Main cash flow streams Unit: Mil. $

Company	Main Cash Flow	2005	2006	2007	2008	2009
HHI	CF from Operating	926	1,639	4,116	2,383	-958
	Net of PP&E	-305	-524	-892	-1,708	-1,053
	Net Borrowings	-457	1	0	-186	886
SHI	CF from Operating	220	1,390	1,462	1,169	-3,162
	Net of PP&E	-380	-407	-590	-962	-689
	Net Borrowings	-355	-51	-1	-4	2,633
DSME	CF from Operating	214	665	1,851	-320	-1,280
	Net of PP&E	-243	-292	-198	-536	-483
	Net Borrowings	-113	-222	-28	-52	1,914
STX	CF from Operating	51	218	1,076	680	-1,409
	Net of PP&E	-61	-60	-171	-207	-152
	Net Borrowings	-74	-104	-34	304	1,396

Source: Annual Reports (1,000 KRW/$)

6.7 Return on Equity

The value of a company can be determined by its profitability and growth. As shown in figure 6.6 below, drivers of companies' profitability and growth can be measured by return on equity. ROE, as a comprehensive indicator of a firm's performance, will be analyzed in depth. If the whole is ROE, then its component parts consist of operating margin, asset turnover, interest burden, financial leverage, and tax expense.

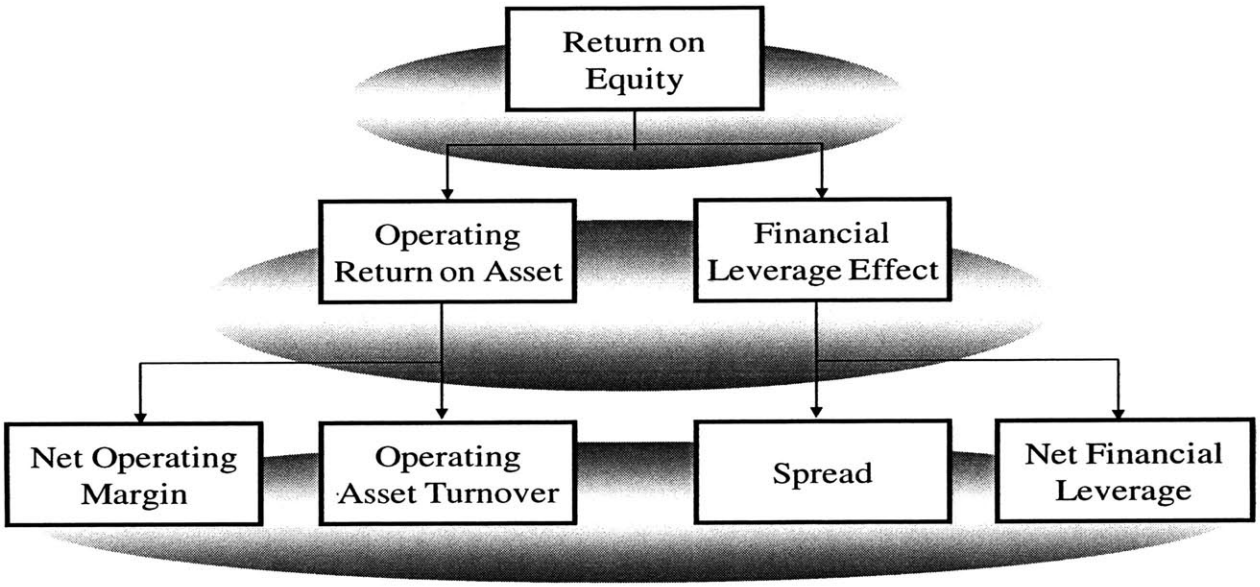

Figure 6.6 Return on Equity (Source: Business analysis and Valuation (Palepu, Healy, Bernard))

As shown in table 6.9 below, HHI's superior ROE was largely driven by its higher net operating profit margin and its better asset utilization; HHI was able to achieve higher ROE than second tier companies in spite of its lower financial leverage ratio. In other words, second tier companies' inferior performance was cushioned by their aggressive financial management. In this financial meltdown, HHI has much leeway to sustain because it can recover cash deficit through capital market.

Table 6.9 Decomposition of ROE

Company	2006	2007	2008	2009	CAGR	Average
HHI	18%	36%	37%	26%	13%	30%
Net Operating Margin	7%	11%	11%	11%	15%	10%
x Asset Turnover	1.1	1.1	0.9	0.8	-10%	0.9
x Interest Burden	1.3	1.4	1.3	1.2	-3%	1.3
x Leverage	3.1	3.1	3.7	3.3	3%	3.3
x Tax	0.6	0.7	0.8	0.8	9%	0.7
SHI	8%	24%	28%	24%	47%	21%
Net Operating Margin	1%	5%	7%	6%	89%	5%
x Asset Turnover	0.8	0.9	0.6	0.5	-14%	0.7
x Interest Burden	3.7	1.6	1.1	1.1	-34%	1.9
x Leverage	3.8	4.9	8.6	9.1	34%	6.6
x Tax	0.7	0.7	0.7	0.8	3%	0.7
DSME	4%	19%	19%	20%	72%	16%
Net Operating Margin	-3%	4%	9%	6%	-221%	4%
x Asset Turnover	1.0	1.0	0.9	0.7	-9%	0.9
x Interest Burden	-0.5	1.4	0.6	1.1	-233%	0.7
x Leverage	3.7	4.2	6.2	5.9	17%	5.0
x Tax	0.7	0.7	0.7	0.8	1%	0.7
STX	9%	25%	4%	-12%	-208%	7%
Net Operating Margin	1%	4%	3%	2%	33%	3%
x Asset Turnover	0.9	0.8	0.5	0.5	-20%	0.7
x Interest Burden	3.0	2.2	0.4	-1.2	-174%	1.1
x Leverage	3.9	4.3	5.7	6.5	18%	5.1
x Tax	0.8	0.8	1.2	1.3	15%	1.0

Source: Annual Reports

Note: Interest Burden (NIBT/Operating income), Leverage (Average Asset/Average Equity)

Return on equity of major shipbuilding companies in Asia has a specific distributional pattern. Within a country, despite the difference in sales revenues, shipbuilders had a similar level of ROE. This might result from sharing same external and internal factors such as exchange

ratio, wages for workforce, and suppliers.

Major Korean shipbuilders' financial performance trended with, but generally outperformed the shipbuilding industry as a whole, driven by the superior quality and value added product mix. Even though Chinese shipbuilders generated lower sales revenues compared to Korean shipbuilders, they enjoyed a similar level of ROE due to low labor costs. A notable fact is that there is a significant disparity between ROE of Singapore and Japanese companies.

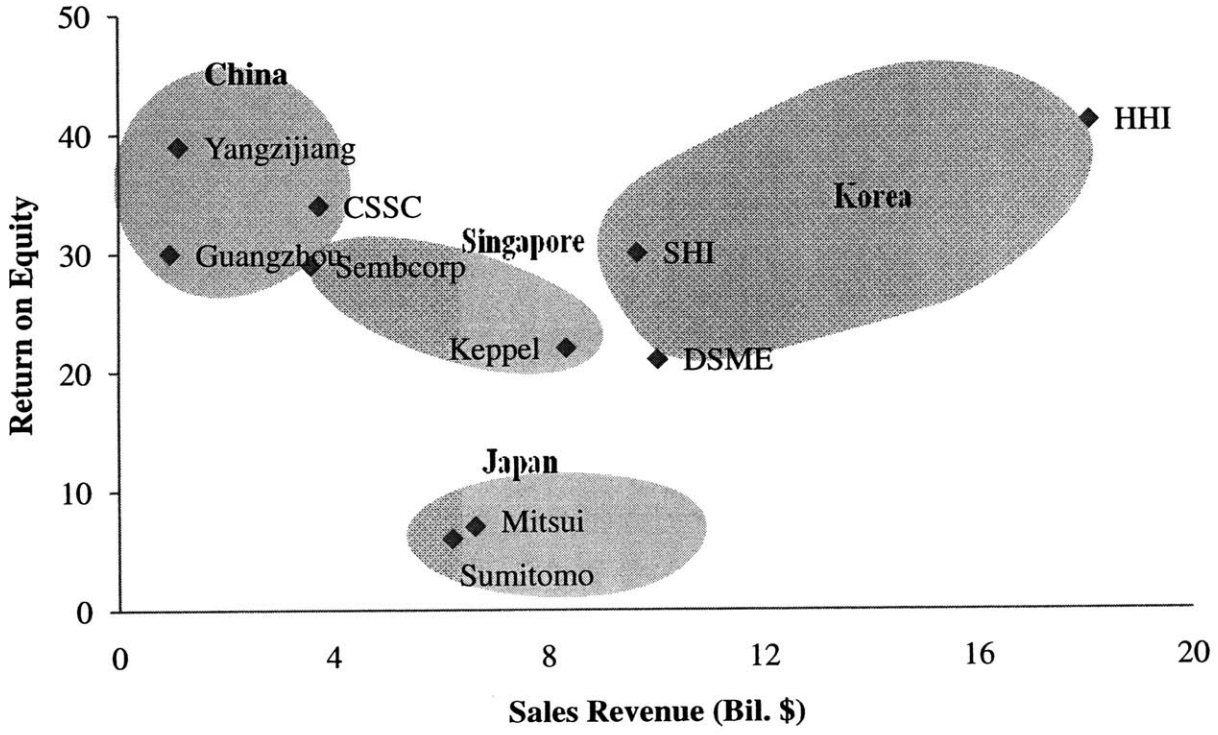

Figure 6.7 ROE of major Asian shipbuilders in 2008 (Source: Annual Reports)

6.8 Summary

The financial information of the four Korean shipbuilders can be summarized as follows. Their sales and operating profits have increased substantially in the previous five years. Interest income has increased in response to the increased new orders. However, in 2009, with a decrease

in new orders, Korean shipbuilders suffered from cash shortage, which resulted in increased financial costs.

Because of cash deficit, they may have difficulty in diversifying their business portfolio actively. However, the profitability of Korean shipbuilders matches or surpasses that of other countries shipbuilders, which means that Korean shipbuilders still have much leeway to raise funds for business diversification. From the long term perspective, by minimizing investment for capacity addition, Korean shipbuilders should implement a diversification strategy so as not to encounter the same fate experienced by the previous leaders such as Britain and Japan.

Chapter 7 Potential Strategy for Korean Shipbuilders

In this chapter, I will first use SWOT matrix framework to summarize the environmental factors, both internal and external, currently impacting the Korean shipbuilding industry. Second, I will use microeconomics to derive implications from current shipbuilding market characteristics and analyze the industry competition in the industry by Porter's Five Forces Model. Third, I will summarize financial constraints that Korean shipbuilders face based on the previous financial analysis. Lastly, I will suggest potential business strategies to enhance competitive advantages by combining the current market situation, Korean shipbuilders' strengths and weaknesses derived from SWOT analysis, and broad implications from market characteristics, Porter's Five Forces, and financial constraints.

Some suggestions as potential business strategies for Korean shipbuilders are: focusing on offshore units, exploiting new market demand, and considering business diversification.

7.1 SWOT Analysis

SWOT analysis will be a starting point of understanding the key factors that will affect improvement of shipbuilders' sustainable competitive advantages. Strengths and weaknesses are derived from the competitive advantages of Korean shipbuilders in Chapter 5; Opportunities and threats are derived from the market analysis in Chapter4. As shown in figure 7.1 below, SWOT analysis highlights what Korean shipbuilding companies should focus on.

Through this chapter, factors that are beyond the control of Korean shipbuilders such as instability of the shipbuilding market and low demand force, factors that need government supports such as domestic financing and shipping market, and factors that are unsustainable such as low steel prices, depreciation of Korean currency, will not be considered. Only the factors that

Korean shipbuilders can manage and control will be handled.

- Strengths: Skilled workforce, Economies of scale, High technology, High productivity
- Weaknesses: Increasing labor costs, Low business diversification, Lack of core technologies in cruise ships and offshore units
- Opportunities: Growth of offshore market
- Threats: China's rise, Over capacity

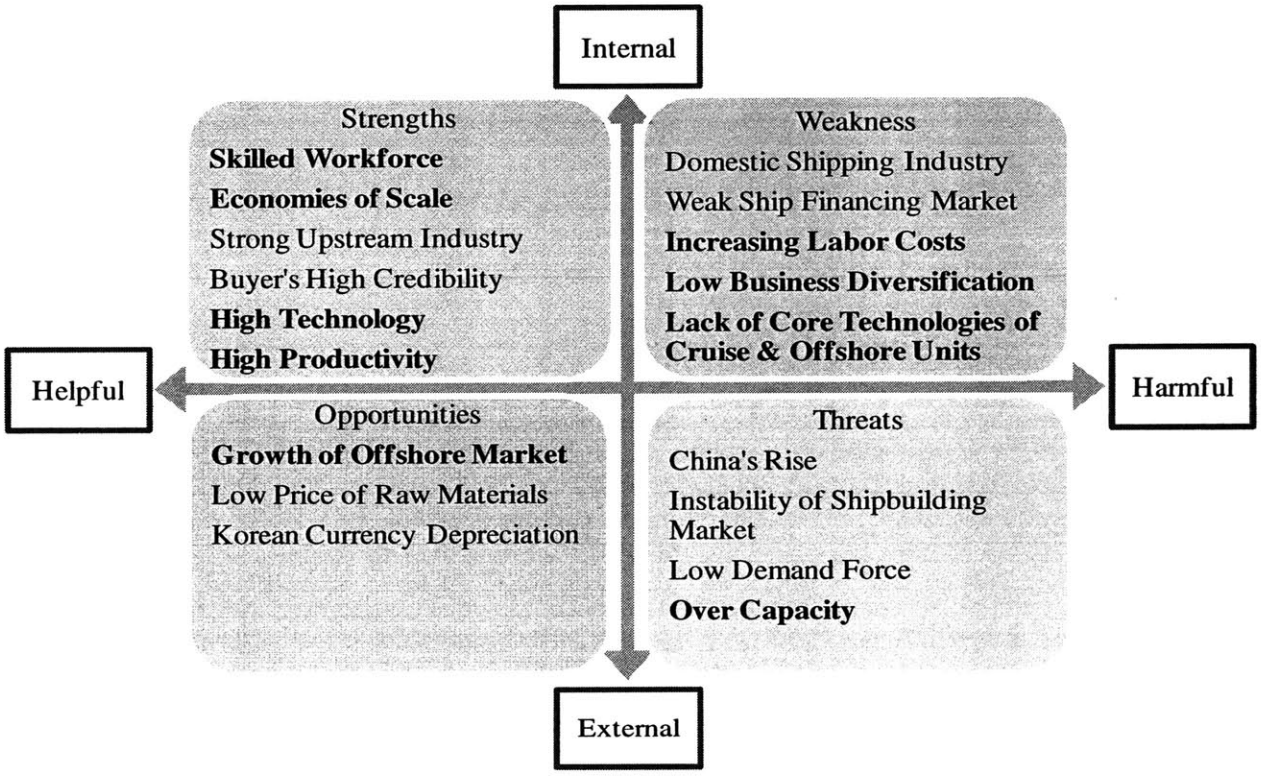

Figure 7.1 SWOT analysis of Korean shipbuilding industry (Source: Author 2010)

7.2 Implications from Market Characteristics

In a perfectly competitive market, it is impossible for market participants to make more profits than their cost of capital due to several conditions: identical products, many sellers and buyers, free entry and exit barriers, and full information. As described above, the shipbuilding

market resembles in part a perfectly competitive market.

- Homogenous products in each ship category
- Many sellers and buyers are price takers
- Single market with information symmetry

Despite the perfectly competitive market characteristics listed above, shipbuilders have different profitability because of the following reasons.

- Quality is important for high value added ships such as gas carriers and offshore units
- Only a handful of shipbuilders can make high value added ships
- Different efficiencies due to different technologies and economies of scale.

It is apparent that a shipbuilder that has competitive advantages in the above conditions can earn excessive profit. As such, potential business strategies should start from improving competitive advantages in the above conditions. If Korean shipbuilders improve these competitive advantages, they can withstand the market downturn because of their relatively low costs compared to the quality. In other words, Korean shipbuilders can show a relatively promising performance when other shipbuilders only enjoy profits that are equal to the cost of capital.

7.3 Implications from Five Forces Model

Porter (1980) described the intensity of competition in the industry as inversely proportional to its profitability. As such, a potential business strategy for Korean shipbuilders can be developed by trying to reduce the intensity of competition.

7.5.1 Threat of Entry

The threat of entry is inversely proportional to the height of entry barriers. There are several factors that determine the height of entry barriers: economies of scale, economies of scope, product differentiation, capital requirement, and cost advantages. (Porter 1980) Historically, the shipbuilding industry had relatively low entry barriers in a simpler ship market and high entry barriers in a sophisticated ship market.

The main reason for low entry barriers in the simpler ship market was that new entrants could easily construct new shipyards and expanded their capacities by raising funds through government's support, and therefore accomplished economies of scale to a certain degree. As mentioned above, a big feature in the general pattern of evolution of the shipbuilding industry has been government support, and therefore, under government protection and support, Japanese, Korean, and Chinese shipbuilders were able to solve their capital requirement problem.

However, the entry barriers in the sophisticated ship market are so high that European shipbuilders still maintain a strong presence in cruise ships and offshore units. The main reason can be summarized as a strong supply chain and basic design capability.

For Korean shipbuilders, the threats of entry are driven not only by the new entrants in the world shipbuilding market but also by Chinese shipbuilders who try to enter into high value added ship market. As Korean shipbuilders are losing their cost leaderships in simpler ship types because of high labor costs, they should concentrate their resources on raising the entry barriers in the high value added ship market.

7.5.2 Rivalry among Existing Firms

Competition, notably price competition, among established shipbuilders is so intense that price cuts take place quickly in the shipbuilding market. As mentioned above, in 2009, the shipbuilding prices decreased by 27% because of the collapse in demand. Also, from 1992 to 2002, there was a 36% decrease in shipbuilding price because of over capacity.

The main reasons for severe price competition can be summarized as high fixed costs, impossibility to store inventory, and high barriers to exit. First, a high fixed cost structure creates pressure for all shipbuilders to fill capacity which often leads to rapidly escalating price cuts when excess capacity is present. (Porter 1980, 1986) Second, shipbuilders are unable to build ships in advance without orders received. A shipbuilder cannot bear financial costs because the cost per ship usually ranges from a hundred million dollars to six hundred million dollars. Third, barriers to exit are high because shipbuilding companies' assets are so specialized that they have low liquidation value, and governments, concerned with detrimental effect on labor market, usually subsidize the shipbuilding companies.

7.5.3 Bargaining Power of Buyers & Suppliers

Bargaining power of buyers is relatively strong in the shipbuilding market because the shipbuilding market is a single global market with information symmetry. For instance, the market information quickly spreads out to the single market participants so that buyers can invite tens of shipbuilders to submit tenders. However, for sophisticated ships, the bargaining power of buyers decreases because only a handful of shipbuilders can build these ships.

Generally, the bargaining power of suppliers is proportional to the condition of the shipbuilding market. First, during an upturn of the shipbuilding market, suppliers of steel plates

and auxiliary ship equipments have a lot of bargaining power because of excess demand. Second, shipbuilding process is so complicated that shipbuilders need each of the components in time in order to avoid bottle necks and meet the delivery date. Lastly, shipbuilders who don't have enough capability to handle basic design will lose more bargaining power with suppliers. A lack of basic design capability will require a lot of revisions in drawing, and therefore lead time for procurement will be shortened.

7.5.4 Shipbuilding Value Chain

"The shipbuilding value chain shows why three production-related factors (procurement of input materials, labor efficiency, and economies of scale in operations) are the major determinants of cost position." (Porter, Competition in Global Industries 1986)

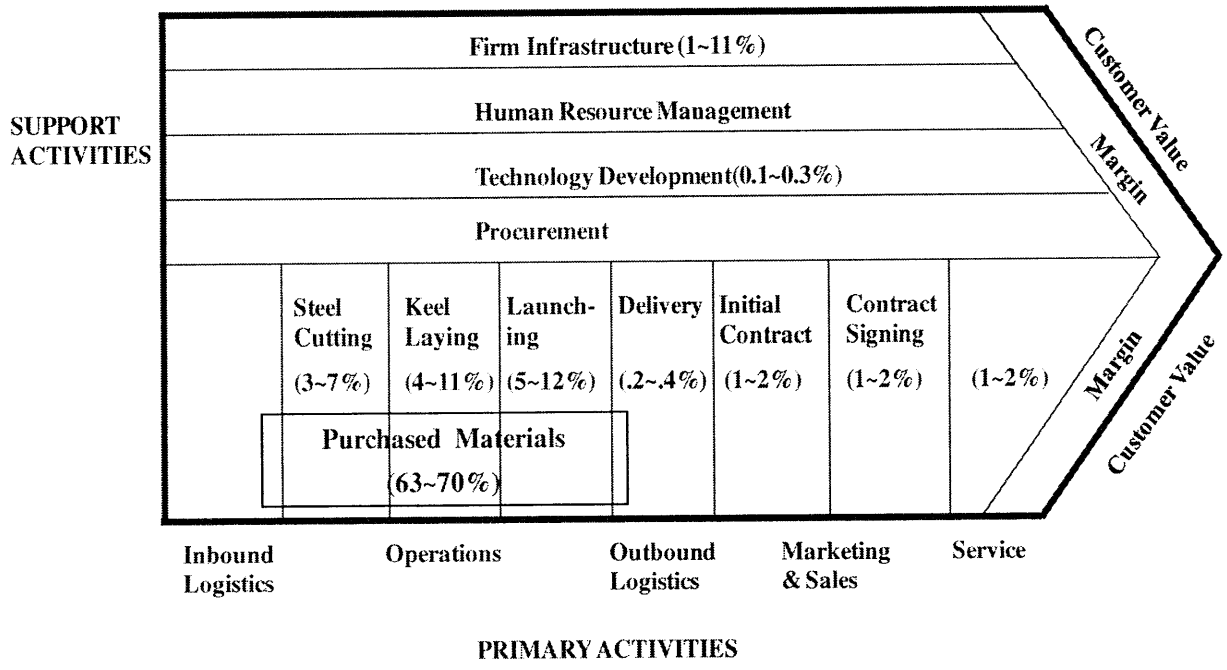

Figure 7.2 Shipbuilding Value Chain (Source: Porter 1986)

The shipbuilding value chain presented in figure 7.2 above describes activities that can create value and the relative portion of total costs in each activity. The prime activities include inbound logistics, production, outbound logistics, marketing and sales, and after services. The support activities include infrastructure management, human resource management, research and development, and procurement. Material costs, labor costs, and infrastructure management costs explain 76% of total costs. This value chain can be applied for relatively simpler ships such as bulk carriers, tankers, and container ships.

However, the activities such as contract management and process management become more important in sophisticated ships such as offshore units. The reasons are as follows.

- Initial contract (Contract management): Contents and clauses of the contract became more critical especially in sophisticated ships. Shipbuilders took part in bidding of offshore units by making a consortium with subcontractors who are responsible for engineering, main equipments, mechanical test and transportation. As such, shipbuilders are also exposed to unexpected risks which could be generated by contract members. This is why clauses of contract regarding guarantees, penalties, specifications, and options are more critical to specify the boundary of obligation.
- Punctual delivery (Process Management): Especially in offshore units, observance of delivery date is critical as customers, oil companies, have a limited time period to extract oil.

7.4 Implications from Financial Analysis

Given the market forecast projected and current trend of financial information, despite a high net income in 2009, big Korean players have a risk to be on the course toward a death spiral

where cash deficit and net income fall into a vicious cycle by harming each other.

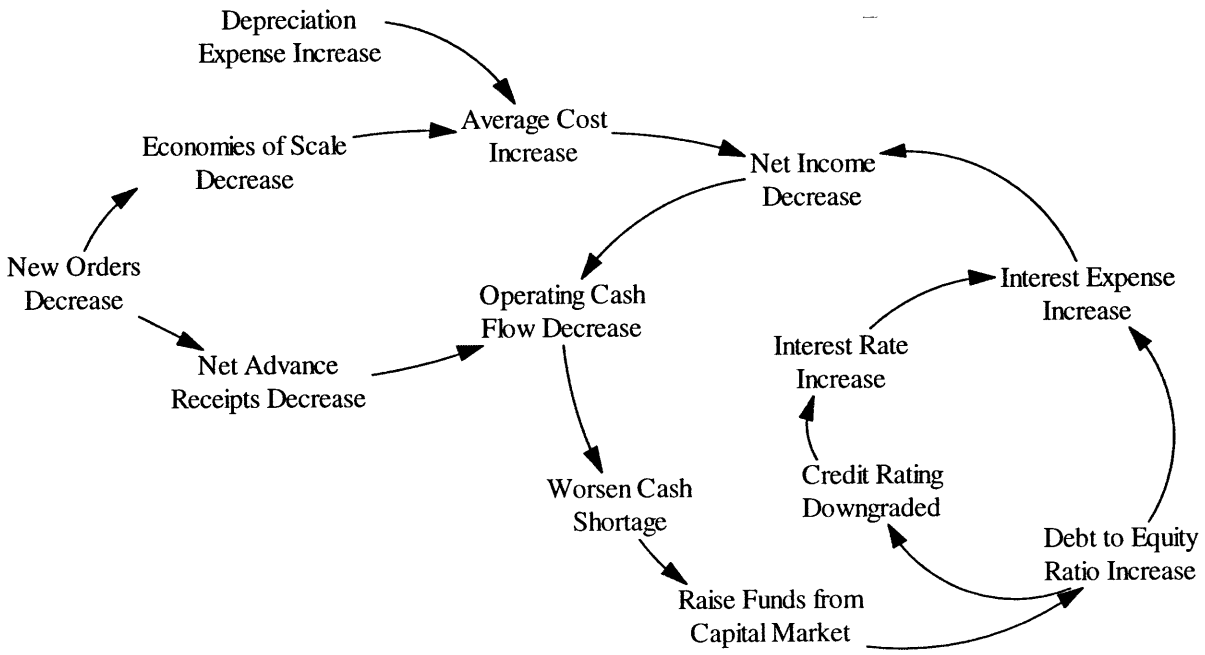

Figure 7.3 Negative reinforcing loops because of decrease in new orders

The starting point is a decrease in new orders that causes loss of economies of scale and cash deficit, at the same time. Once the vicious cycle starts, it will not stop until annual new orders remain constant after declining. Furthermore, depreciation expense, expected to increase in the coming years, will magnify the death spiral by increasing average cost per output.

In this regard, cash management is a critical point that major Korean shipbuilders should focus on. Possible ways to avoid a cash crisis are as follows. First, in order to increase operating cash flow, major Korean shipbuilders should enhance profitability by changing their product mix, exploit new product, and create new cash stream by business diversification. Second, in order to increase investing cash flow, they should change their investment strategy from capacity expansion to process improvement. Considering that the capacity expansion is the main portion

of investment and that the current shipbuilding market is definitely in an over capacity stage, Korean shipbuilders should cease capacity expansion and focus on process improvement.

7.5 Suggestions

7.5.1 Focus on Offshore Units

Korean shipbuilders should accomplish a true source of competitive advantage by developing basic design capability and strengthening supply chain in offshore units, which will enable them to differentiate themselves from competitors.

As mentioned above in Chapter 5, three major Korean shipbuilders' order book mixes of offshore units range from 26% to 51% in dollars, which means that Korean shipbuilders are already focusing on offshore units. However, even though overall design and production technologies of Korean shipbuilders surpass those of Japanese and Chinese shipbuilders[31], it is also true that Korean shipbuilders have been a simple production center of offshore units without basic design capabilities.

Traditionally, Korean shipbuilders take part in bidding for offshore units by making a consortium with subcontractors who are responsible for basic design, main equipments, mechanical test and transportation. The problem is that offshore units are highly customized rather than standardized, so that customers' change order requests result in revisions of basic design. For instance, when basic designs were revised to reflect change order requests, Korean shipbuilders suffered from shortened lead time for procurement and production, and therefore the shortened lead time caused substantial increases in manufacturing costs.

[31] Refer to table 5.5

In addition, Korean shipbuilders should strengthen their supply chain, especially in main equipments. In offshore units, suppliers of main equipments are not diversified and localized, and therefore the suppliers have relatively strong bargaining power over Korean shipbuilders. If the suppliers are localized and diversified, Korean shipbuilders can manage procurement process efficiently and reduce the costs of main equipments.

Considering the current market downturn, over capacity, and the cash deficit faced by Korean shipbuilders, they should focus on process improvement not only by enhancing their basic design capability instead of capacity addition but also by diversifying vendors of main equipments. Process improvement will not only decrease in manufacturing costs as a result of managing lead time effectively but also increase in customers' satisfaction by incorporating their specifications.

7.5.2 Exploit New Market Demand

In the coming five years, even though a strong demand in offshore units may fill in Korean shipbuilders' existing capacity[32], they will continuously lose market share in low value added ships such as bulkers and containers, which means that they should do their best to exploit new shipbuilding market demand.

Historically, the main drivers that have created new market demand can be summarized as change of regulations, needs of ship buyers, and needs of other industries.

- Change of regulations : The substitution of single hull tankers for double hull tankers
- Needs of ship buyers: 14,000 TEU containers (Operational efficiency), Icebreaking tankers (Icebreaker + Oil tankers)

[32] As mentioned above in Chapter 4, the need for the deep-water exploration will increase the demand in offshore units.

- Needs of other industries: LNG FPSO (No needs for fixed platform, subsea pipe lines, and onshore plant), Offshore Wind Turbine Installation Vessel

Korean shipbuilders should make a various efforts to arouse potential ship buyers' interest in placing orders by producing attractive ships. For instance, the shrinking of oil reserves in shallow water is anticipated, and therefore deepwater oil production will be accelerated and new Arctic oil exploration will be triggered.

Also, IMO has discussed Green House Gas (GHG) emissions from ships and there is a strong movement to regulate CO_2 emissions[33] per ship. IMO is considering the introduction of carbon caps or GHG fund in the foreseeable future. In this case, IMO regulation will cause severe competition among shipbuilders toward achieving fuel efficiency, which means that shipbuilders' competitive advantage will shift from cost leadership to technology leadership.

Korean shipbuilders should try to achieve technological leadership to enjoy first-mover advantage in these new expected markets.

7.5.3 Consider Business Diversification

Historically, Korean shipbuilders have implemented vertical integration, which is a typical way to diversify in the shipbuilding industry by incorporating the processes of upstream industries or downstream industries. Korean Shipbuilders, for instance, expanded their production process to make main equipments such as engines in order to ensure timely supply and reduce transaction costs. HHI has its own engine division; STX has an engine company as an affiliated company under the same holding company. SHI also holds 32% of stocks of an engine

[33] IMO GHG Study 2009 estimates that ships emitted 1046 million tonnes of CO2 in 2007, which corresponds to 3.3% of the global total. In the absence of global policies to control greenhouse gas emissions from international shipping, the emissions may increase by between 150 and 250% by the year 2050 due to an expected continuous growth in both world population and international trade.

company. In case of downstream vertical integration, STX has a shipping company as a subsidiary and HHI is trying to acquire a shipping company. With regard to backward integration, thus far, Korean shipbuilders generated profits by securing main equipments, reducing transaction costs, and simplifying procurement procedures. For instance, operating margin of engine division in HHI was 23% in 2008, which meant that HHI could reduce the cost of engine by 23% compared to other shipbuilders who purchased marine engines from other suppliers.

From now on, Korean shipbuilders should consider business strategies of non-integrated diversification. Historically, in the 1970s, Japanese shipbuilders reduced their portion of sales derived from shipbuilding. This trend was a natural response to the long term downturn in shipbuilding and over capacity problem.

Table 7.1 Diversification out of shipbuilding by Japanese shipbuilders

Shipbuilder	Shipbuilding Portion in terms of Sales (%)	
	1974	1981
Hitachi Zosen	64	33
IHI	41	25
Kawasaki	28	15
Mitsubishi	37	19
Mitsui	63	33
Sasebo	63	51
Average	49	29

Source: (Todd 1985)

In the current market downturn, it is acknowledged that there may be financial constraints for Korean shipbuilders to pursue business diversification because of cash deficit. However, from the long term perspective, Korean shipbuilders should try to lower their shipbuilding portion as a priority. Otherwise, they may suffer from shipbuilding market downturn whenever it

occurs, and eventually encounter the same fate of the previous leaders such as Britain and Japan.

7.6 Conclusion

In the shipbuilding industry, common interests of shipbuilders are: optimizing the facilities, economizing the capital expenditure, maximizing the production efficiency, and minimizing the manufacturing costs. It is obvious that Korean shipbuilders succeeded in these conditions, and therefore kept market lead position. However, because of total collapse in demand, over capacity in supply, and threats from Chinese shipbuilder, it is also true that Korean shipbuilders are expected to encounter the unprecedented difficulty.

Korean shipbuilders should try their best to reveal market opportunities hidden beneath the current market recession considering their competitive advantages and available resources. Therefore, at this moment, I suggest potential business strategies that they can implement as follows.

- Focus on offshore market by enhancing basic design capabilities and diversifying
- Exploit new market demand by identifying customers need
- Consider business diversification to lower the portion of shipbuilding

Lastly, it is needed for all the shipbuilders to work together on this market downturn, which will enable to shorten the recession, and stimulate the rebound of the shipbuilding market.

Appendix 1 Measurements of the capacity of the ship

Shipbuilding is generally quantified in terms of tonnage. However, there are several distinct measures of tonnage that are applied for different purposes.

- DWT (Dead Weight Tonnage) refers to the weight of cargo and commodities that a ship can carry in metric tonnes. It is less reliable as a comparative measure of size of ship than gross tons because it is strongly influenced by the density of the cargo. It is used generally to measure size of bulk cargo carriers and is a basis of price and fright rate of bulk cargo carriers.
- GT (Gross Tons) is the fundamental basis of the physical size of a ship. It refers to the volume enclosed by the ship's hull. All registered ships will be assessed for their gross tonnage and this is the parameter normally referred to when the size of a merchant ship is quoted in tons. It is used to determine things such as a ship's manning regulations, safety rules, registration fees and port dues. It is a standard to measure shipbuilders' capacity of completion and orders received.
- CGT (Compensated Gross Tonnage) is modified the GT by a compensation factor relating to the complexity of the building process. CGT was needed because gross tonnage alone was not adequate as an indicator of work content or capacity in shipbuilding. Production process and productivity relatively vary by size and type of ships. The system has now been highly developed and is fundamental to the analysis of shipbuilding activity.
- TEU (Twenty-foot Equivalent Unit) is the basic measurement of the cargo carrying capacity of a container ship. 10,000 TEU container ships can carry 10,000 containers at most.
- Cubic Meter (CBM) is the special measurement to calculate the capacity of gas carriers.

Source: (First Marine Limited International 2003)

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