



Harvard Business School

Microeconomics of Competitiveness



FINAL PROJECT:

SHIPBUILDING CLUSTER IN THE REPUBLIC OF KOREA



Advisors
Professor Michael E. Porter
Dr. Christian Ketels

John Chen
Martin Galstyan
Du Huynh
Selvendran Katheerayson
Vicente Mendoza

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Context for the Report

This report was prepared by students of *Microeconomics of Competitiveness*, joint course for Harvard Kennedy School and Harvard Business School students taught by Professor Michael Porter. This course is based on Professor Porter's competitiveness theory and extensively uses "Diamond" theory of economic development articulated in his book *On Competition* (Porter 2008). Core principals of The "Diamond" theory reside on region/country/state/cluster's competitive position and are based on four pillars of competitiveness: factor conditions, demand conditions, related/supporting industries, and firm strategy, structure and rivalry. The main purpose of the Course was to cover a range of issues related to countries and clusters, all at differing stages of socioeconomic development, and analyze positive and negative efforts to upgrade competitive advantage. Our report is an effort to incorporate the lessons and to use the framework taught during the class using the case of Republic of Korea and shipbuilding cluster in Korea in particular. Unless otherwise stated, the views and recommendations expressed in this report are those of the authors, based upon the interpretation of raw data collected via interviews and other sources.

Acknowledgments

The authors would like to thank the 6 post graduate students from Harvard University and Massachusetts Institute of Technology of Korean nationality for their tremendous support and dedication. We have included their inputs but kept their names anonymous per their request. None of the group members are Korean nationals have worked or travelled to Korea.

EXECUTIVE SUMMARY

Korea's history is an example of discipline, hard work and constant effort to improve. With more than nine hundred invasions in two thousand years of recorded history, the country started the transformation of its economic system after Park Chung-hee took over the presidency, establishing new policies that built a new Korea at the end of the 20th century. With *Chaebols* as the growth engines of an export oriented economy, Korea transformed from an agricultural nation to one of the most successful high-tech centers of the world, excelling by its state of the art technology and innovation. At first glance Korea's strategy seems to have paid off, with a GDP per capita around US\$ 28,000, compared with only US\$100 in 1963, however, the country is lagging behind its main competitors in several areas, including the efficiency of its labor market, the sophistication of its financial system and the development of its institutional framework. Although Korea's GDP per capita has significantly improved in the last 50 years, the country is still facing some of the traditional problems of medium developed nations.

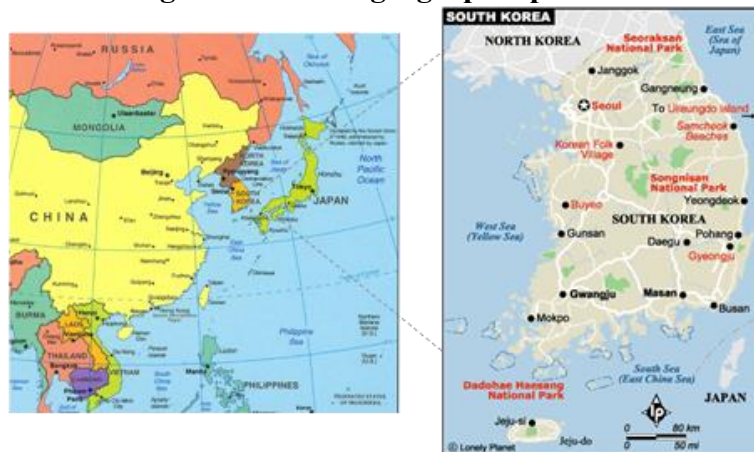
The Shipbuilding Cluster started with almost nothing in the 1950s with the exception of a proud heritage of having once being a successful oceanic nation in the 16th century. Yet, in 2004, it emerged as the world's leading shipbuilding nation overtaking Japan and European nations who dominated the industry for centuries, a position it still holds on to precariously. Historically, the cluster benefitted from national investments in world class shipbuilding infrastructure, institutional capacity and specialized educational establishments, coupled with a relentless pursuit by shipbuilders and its suppliers to continuously enhance production efficiency. Its biggest challenge moving forward would be in stimulating domestic demand, realigning its research and development initiatives to support cluster objectives and a structured move away from 'manufacturing' to a 'services' focus strategy in the lower segment.

I. Country Analysis

1. Country Background

Located on the southern half of the Korean Peninsula in East Asia, the Republic of Korea (ROK), occupies an area of approximately 38,600 square miles, about the size of the U.S. state of Indiana, with more than 1,500 miles of coast line. The country is situated in a strategic neighborhood between China, Japan, and Russia, a location that has influenced its economic and political development. It has suffered nine hundred invasions, in two thousand years of recorded history, and five major periods of foreign occupation by China, the Mongols, Japan, and, after World War II, the United States and the Soviet Union (Jonsson, 1995).

Figure1. Korea's geographic position



With a population that is expected to exceed 51 million people in 2010 (Chamberlain, 2010), Korea stands as the third most densely populated country in the world. Its aging population, declining birth rates and increasing per capita income, make its demographics more related OECD countries. Different philosophies have contributed to the development of Korea's pluralistic culture, but none has influenced it as deeply as Confucianism, shaping the central values of today's Korean society: respect, education, hard work and public service.

In the 16th century, Japan began its major expansion under the rule of Hideyoshi Toyotomi who attacked Korea as the first phase of the Chinese invasion (Oberdorfer, 1988). The Korean navy fought back with an early class of ironclad warships known as turtle ships, which inflicted severe losses on the Japanese. In the wake of the Japanese invasion Korea established a rigid policy of excluding foreigners, beginning an era of isolation that ended in the 19th century when the US, Europe and Japan, sent warships forcibly to open the country to trade (Jonsson, 1995).

In 1904 Japan and Russia engaged in war and after Japan's surprising victory, it occupied Korea in 1905 and annexed it as a Japanese possession in 1910. Japan then ruled as the harsh colonial master of the peninsula until its defeat in World War II, when the country came to be divided into two "temporary" zones of occupation.

Korea, with its democratically elected government with Syngman Thee as President declared its independence as the Republic of Korea in August 1948. North Korea was incorporated into the totalitarian camp headed by the Soviet Union and established itself as the Democratic People's Republic of Korea (DPRK) in September 1948. Since then, Korea has lived under the threat of invasion, a factor that has determined its need to constantly improve its economic condition.

2. ECONOMIC TRANSFORMATION

During the 1950s after the attack of DPRK to reunify the Korean peninsula, Korea remained as a closed economy, implementing an import substitution model. In 1953, at the end of the Korea War, the US and the ROK became treaty allies to deter foreign aggressions against the country. In 1961, Park Chung-hee took over the presidency, bringing military authority, discipline, and organization to the country and establishing new policies that powerfully shaped Korea for the rest of the 20th century. President Park initiated the change from an agriculture based model to a model based on manufacturing, services, and a strong reliance on exports. He assumed an active

leadership in shaping the economic environment; implementing major reforms in a combination of state capitalism and five year economic plans.

The government defined the companies –*Chaebols*– that would be the growth engines of the new export oriented economy and supplied them with policy incentives that included domestic market protection, capital trough policy loans, preferential interest rates, limits on labor unions, promotion of exports and barriers to imports. It also determined what kind of plants to build and what products to export, and restructured all industries to promote competition, though in some cases it was also eliminated.

In 1961 the government established the *Economic Planning Board* led by the Prime Minister, with the objective to set specific export targets in each industry which if met would yield additional subsidized credits and access to growing domestic markets. From 1962 through 1996, Korea focused on the development of technology and skilled labor intensive industries (1970-1981), the creation of technology intensive clusters (1982-1986); the development of human capital (1987-1991) and the specialization of *high-tech* industries (1992-1996). Korea's exports expanded from less than 5% of nominal GDP to around 30%, with steady improvements in technological sophistication (Chamberlain, 2010). Korea was able to accelerate its transition to a developed economy achieving an average economic growth of 6.9%.

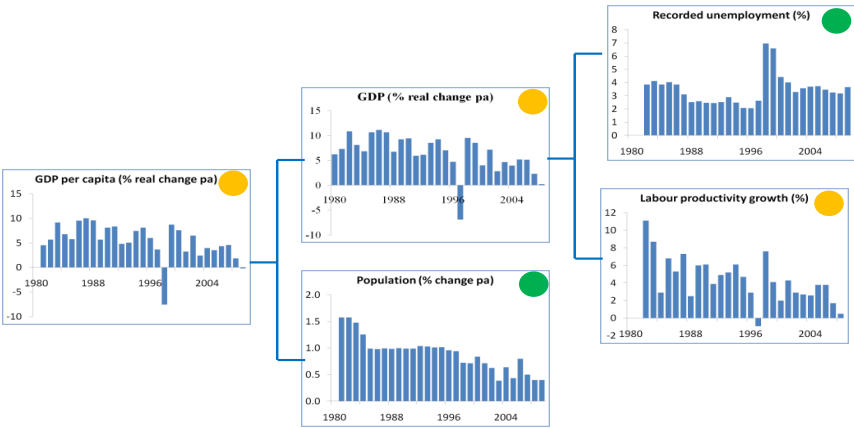
However, not everything going well and the economic and institutional model proved its weaknesses during the 1970s, 1980s and 1990s. During the 1970s oil crisis and high inflation affected Korea's exports and government's efforts to stabilize public finance resulted in recession, corporate failures and high unemployment. During the 1980s, economic crises continued and Korea was forced to accumulate US \$46.8 billion of foreign debt which in 1985 represented 56% of Korea's GNP (Bang, 2007). Korea became the world's fourth largest debtor

in terms of outstanding foreign debt, along with Brazil, Mexico, and Argentina. The Asian Financial crisis of 1997 forced the country to move towards a more liberal economic model, adopt a prudent fiscal and monetary policy and give full autonomy to the Central Bank in 1998¹ with mandate of price stability. Korea achieved an average budget surplus of 1.3% of GDP and an average inflation rate of 2.9% between 1999 and 2008 (EIU, 2010).

3. RECENT ECONOMIC PERFORMANCE

In 2008, Korean PPP-adjusted GDP per capita was US\$ 28,000, compared with only US\$100 in 1963 (EIU report, 2010). Its total exports reached US\$ 422 billion in 2008, 2.6% of total world exports and 6.5 times the level of 1990. However, the country is still lagging behind its main competitors with a GDP per capita 20% below Japan’s, 21% below Germany’s and 23% below Taiwan’s, and there is an excessive concentration of growth with Seoul and adjacent cities generating nearly half of Korea’s GDP (McKinsey Quarterly, 2010). The unemployment rate reached 3.18% in 2008, higher than the 2.46% achieved in 1980 (EIU report, 2010).

Figure 2. Economic performance in Korea: drivers of economic growth

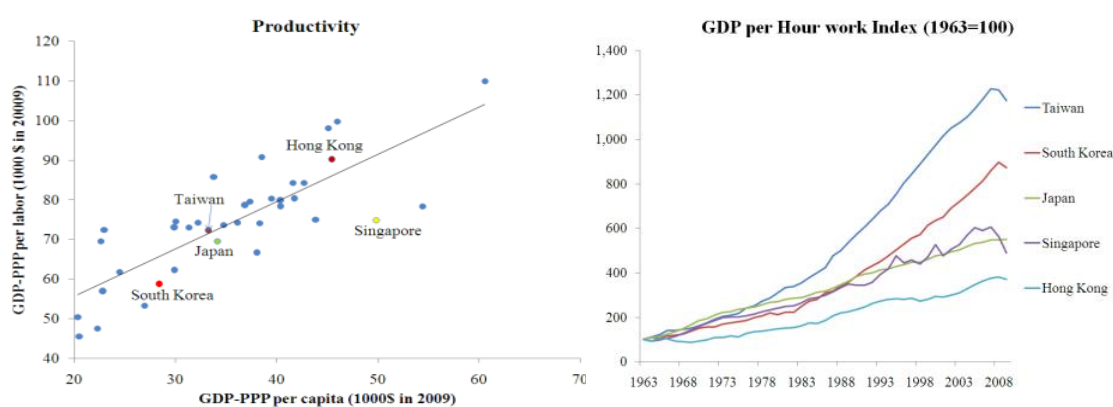


Source: EIU, 2010

¹ www.bok.org.kr

Between 1997 and 2007, Korea's labor productivity grew at an average annual rate of 3.2% still lower than Taiwan at 3.4% (EIU report, 2010). Despite its productivity growth Korea is still lagging behind its main competitors in absolute terms. Services industry was responsible for 56.2% of Korea's labor productivity growth in 1990s, but the ratio fell to 46.2% in 2000s, while the manufacturing sector contribution grew from 30.4% to 46.6%². From 1990 to 2009, the GDP per person employed increased by 90.14%, reaching US \$58,817, however, an hour worked in Korea produces on average 22.5% less output than in Taiwan, 26% less than in Japan, 52% less than in Germany, and 55% less than in US (The Conference Board, 2010).

Figure 3. Economic productivity and GDP per hour work index in Korea

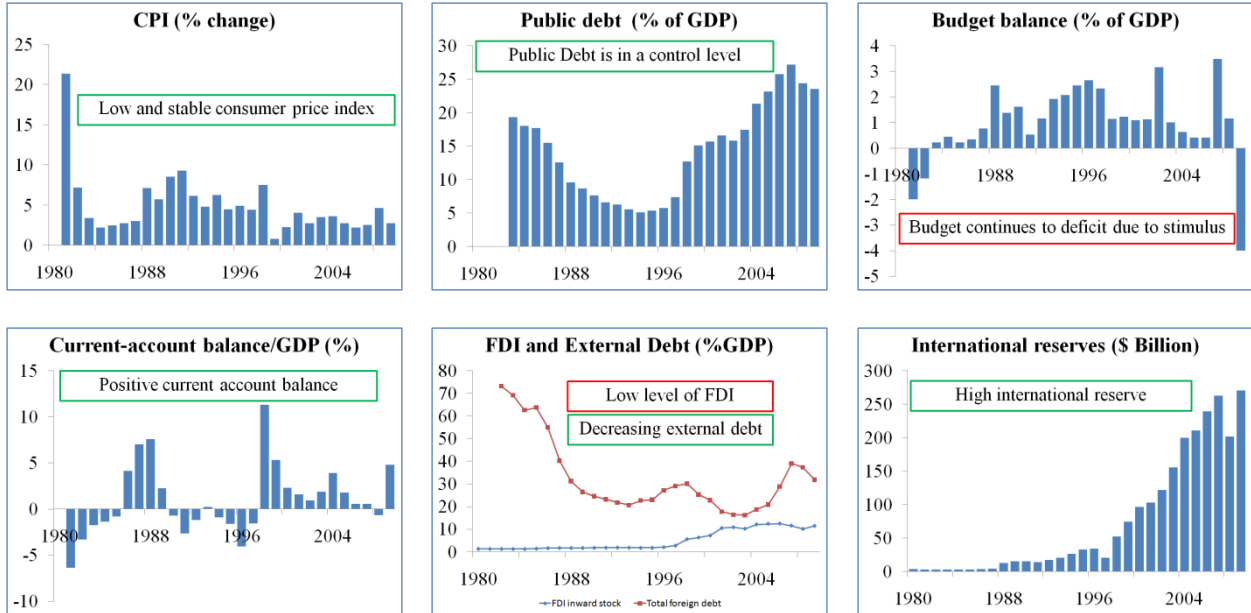


Source: OECD, labor statistics database

Korea's macroeconomic performance has been positive. The government has maintained an average inflation rate of 2.99% in the last five years and a positive average current account balance of 1.42% between 2000 and 2008. As an example of its macro stability, the country achieved an historical level of international reserves, around US \$255 billion in 2008 (EIU report, 2010). Foreign Direct Investment (FDI) as a proportion of GDP reached only 11% in 2008, the second lowest among OECD countries (EIU country data, 2010).

² www.koreatimes.co.kr/www/news/biz/2010/02/123_60695.html

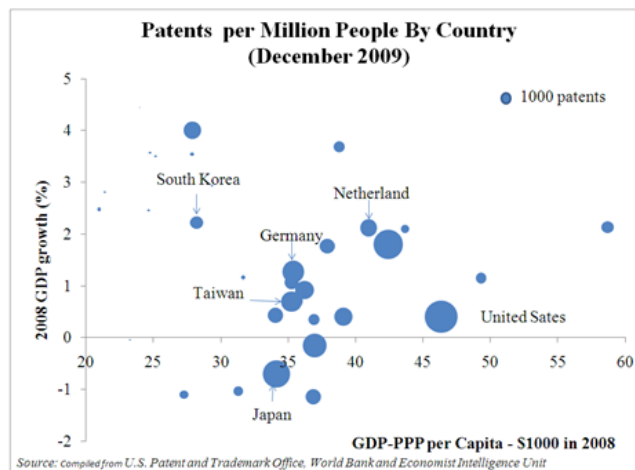
Figure 4: Internal and external economic indicators for Korea, 1980-2009



Source: EIU country data, 2010

Korea's R & D spending of 3.2% of GDP is significantly above the OECD average of 2.2%, China (1.2%), Taiwan (2.4%) Germany (2.5%) and the US (2.6%), but still lower than Japan (3.4%) (OECD, 2010). In recognition of this, the government recently announced the decision to expand tax deductions for business investments in research and development.

Figure 5: Patents per million people, Korea and main competitors



Korea's position with respect to the number of patents per million people ranks 17th worldwide, lagging behind US (1st), Japan (3rd), Germany (5th) and Taiwan (6th). Universities only accounted for 2.3% of patents in 2003-2005, much lower than Singapore (10.2%). Combination of foreign ownership of domestic inventions and patents with foreign co-inventors in 2003-2005, is less than 10% of total patents, much lower than its main competitors (OECD, 2010).

Finally, Korea performs well on the Human Development Index, ranking 26th on the last report, with particularly high scores for gross enrollment ranking 9th (98.5%) and life expectancy at birth, ranking 25th. Under this scenario the current administration under the leadership of President Lee Myung-bak has set a new challenge, the "747 Plan", consistent of achieving an annual growth of 7% of GDP, a \$40k per capita income, and a rank of 7th among the largest economies in the world.

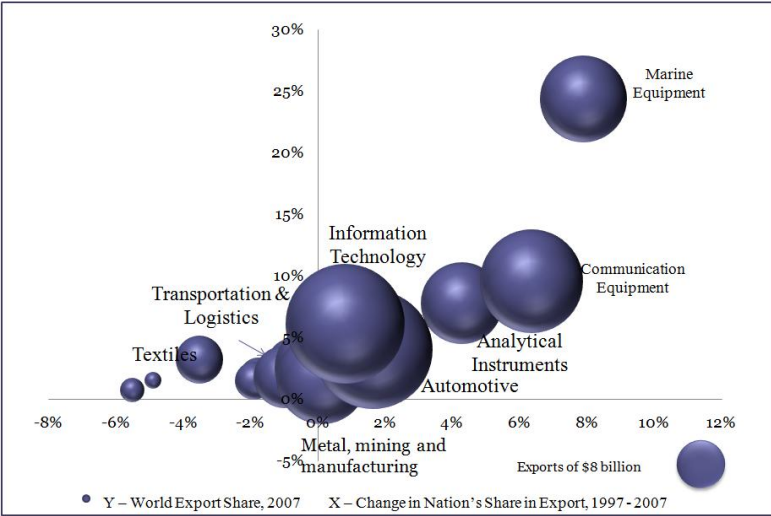
4. COMPOSITION OF THE ECONOMY

Once being an agricultural nation, today agriculture represents only 2.6% of GDP, with industry (36.4%) and services (49.6%) leading the economy (EIU report, 2010). However, services remain weak employing only 66% of Korea's workforce in 2008, compared to 70% in Japan and 85% in the US (McKinsey Quarterly, 2010).

Korea's existent clusters are the result of the policies implemented during the transformation period by both the public and private sector. By 2007 Korea's largest and most competitive clusters are the marine equipment cluster with an export value of US \$27.5 billion, ranking 1st in the world, communications equipment (\$39.2) ranking 2nd; Transportation and Logistics (\$33.8) ranking 5th; Information Technology (\$52.5) ranking 6th, Metal Mining & Manufacturing (\$29.2) ranking 13th; Automotive (\$51.8) ranking 9th, and Oil and Gas Products (\$30.5) ranking 17th (ISC, 2010).

In the 1990s the government start implementing positive measures to encourage the promotion of SMEs, which today comprise 99.8% of all the Korean firms, 50% of manufacturing output, 80% of service sector output and 90% of total employment (Mckinsey Quarterly, 2010). However, the government has not reinvented its methods to promote economic growth and it is providing SMEs with subsidies, financial assistance, and tax incentives that contrary to enhance competition, diminish innovation, business sophistication, and efficiency.

Figure 6. Korean export portfolio by Cluster, 1997-2007



Source: Institute for Strategy and Competitiveness, 2010.

SMEs that are intimately related to *Chaebols*, either as subsidiaries or related companies in the industry seem to be more successful, reflecting that *Chaebols*, considered by the government as too big to fail, still control Korea’s economic activity, accounting for 60% of total exports.

5. ASSESSMENT OF THE NATIONAL BUSINESS ENVIRONMENT

Overall Korea ranked number 19th in the *Global Competitiveness Report 2009-2010*, losing six places in only one year³. Korea’s primary strengths are on macroeconomic stability (11th),

³ The Global Competitiveness Report, 2009-2010. Ranks out of 133 countries.

market size (12th), technological readiness (15th), higher education and training (16th), and infrastructure (17th). It remains as one of the world's innovation powerhouses (11th).

Korea shows serious weaknesses in its labor market efficiency (84th), financial market sophistication (58th), and institutions (53rd). The business community's discontent about the difficulty of hiring and firing employees (108th) is particularly pronounced and mirrored by Korea's low rank in the World Bank's Doing Business rigidity of employment index (92nd), and although a major labor law reform bill aimed at increasing flexibility, it has yet to be approved by the parliament (WEF, 2010).

Despite the waves of consolidation and restructuring since 1997, banks are still very much seen as unsound (90th) and sophistication is low (WEF, 2010). For instance, capital raised through IPOs in 2008 was only 0.35% of GDP compared with Singapore's 1.01% of GDP (EIU, country finance, 2010).

With respect of its institutional quality Korea ranks 53rd, reflecting a general dissatisfaction with the government, the trust in politicians (67th), the perceived opacity of policymaking (100th), and the burden of red tape (98th) (WEF, 2010). In addition, the governance analysis of Kaufmann & Kraay concludes that Korea is lagging behind its competitors in 5 out of 6 pillars evaluated; voice and accountability, political stability, regulatory quality, rule of law, and control of corruption (Kaufmann & Kraay, 2009)⁴. In the Corruption Perceptions Index 2008 Korea ranked 40th out of 180 countries, worst than Germany (14th), Japan (18th), US (18th), and Taiwan (39th), (Transparency International, 2010). Transparency International has expressed its concerns about the lack of autonomy of the Korean Independent Commission against Corruption, almost entirely appointed by the president.

⁴ *The country only passed in the Government effectiveness category.*

Finally, there are some other strategic areas where Korea is lagging behind. Although it excels in its education parameters the quality of math and science education in Korea remains low, ranking 18th, below Singapore (1st), Taiwan (6th), and Hong Kong (11th). Korea is also lagging behind in its local availability of specialized research and training services (35th), compared to Singapore (14th), Taiwan (22nd), Hong Kong (20th), and Japan (13th) and in relative terms Korea's innovation is less competitive than US (1st), Japan (4th), Taiwan (6th), and Germany (7th). In buyer's sophistication, which measures if buyers are making decisions based only on price or based on a sophisticated analysis of performance attributes, Korea ranks 15th, well behind Japan (1st), Taiwan (4th), Singapore (6th), and Hong Kong (7th), (WEF, 2010).

KOREA'S NATIONAL DIAMOND

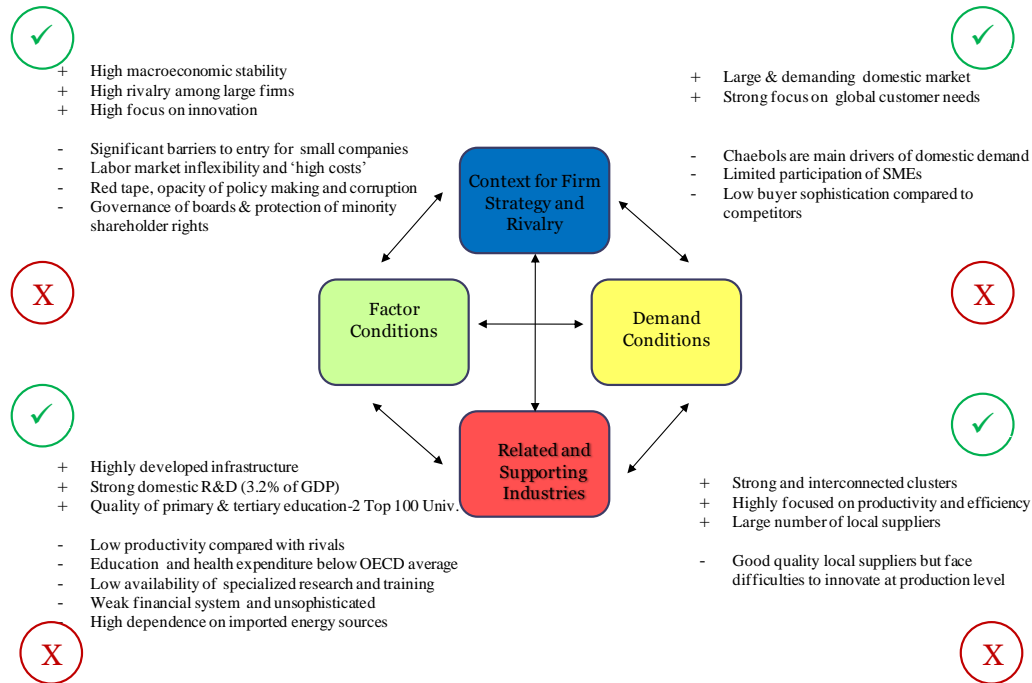
Factor Conditions: Korea has a highly developed infrastructure that facilitates market connectivity with high quality roads, port and air transport infrastructure. The quality of its electricity supply is among the top 20 in the world (CIA, 2010). Despite its low level of expenditure on educational institutions per student⁵, Korea has a high quality of primary and tertiary education, however, it has lagged behind in terms of specialized research and training to support business development. Moreover, although the country invests heavily in R&D, it seems to be strongly oriented to *Chaebols*, and no efforts to integrate inputs from different players exist, missing the opportunity to expand into other technological areas.

Korea's health expenditure is very low, only 6.3% of GDP, the second lowest of 26 countries in OECD's database; and the number of doctors per a thousand people is only 1.7, ranked 39th of 60 countries (EIU report, 2010).

⁵ In primary through tertiary education in 2006 ranked 20 of 33 OECD countries, with US \$6,800 below the average of OECD at round \$9,000.

Access to capital is a key driver to maintain its economic growth; however, Korea has major challenges to modernize its financial system, in particular to enhance the soundness of banks. Financial depth and savings are high⁶, the financial system remains unsophisticated and the availability of venture capital and private equity is very low (WEF, 2010).

Figure 7. Korea's National Diamond



Demand conditions: The country has a large and demanding domestic market ranking 13th in the world. The proportion of expenditure on sophisticated and manufacturing products and luxury services is high and electricity consumption per capita (kWh) is ranked 9th in the world (CIA, 2010). However, *Chaebols* are still the main driver of the domestic demand, with a limited participation of SMEs and especially the service sector. In addition, buyer's sophistication as an engine of upgrading and innovating is still low compared with Korea's main rivals.

⁶ The ratio of total financial assets to GDP in 2009 is 5.3 times, ranked 23rd of 60 countries in EIU database. The saving to GDP ratio has been maintained at 30% for a long time while the investment to GDP ratio is around 28% for the same time.

Context for Firm Strategy and Rivalry: Although the country enjoys one of the most stable macroeconomic environments in the world, this is perhaps the weakest part of Korea's national diamond. While it has succeeded in promoting a highly competitive environment among *Chaebols*; entrance barriers for SMEs are still high; red tape, lack of accountability and corruption prevailing in the country has negatively affected FDI attraction, limiting Korea's ability to bring new skills, capabilities and technologies; improve local factor conditions; infuse modern ways of managing and competing, and in general stimulate cluster development. This situation exacerbates as Korea's labor market efficiency is still full of rigidity and expensive firing costs.

Related and Supporting Industries: The developmental business policy implemented by the country resulted in multiple supporting industries around manufacturing, which enabled the country to build strong and interconnected clusters that complement each other- electronics, automotive, shipping, appliances & shipbuilding. Although most of these industries are highly focused on productivity and innovation it is difficult for suppliers to keep the pace and innovate. The high bargaining power of *Chaebols* has determined the role of the private sector since SME's competition is limited, and only those who are deeply connected to *Chaebols* seem to succeed as suppliers. SMEs' ability to compete in the industry is strongly determined by the strategies and goals of *Chaebols*.

Cluster Policy: Korea does not currently have a national cluster policy. However in recognition to competitiveness' challenges, the President established in 2008 the Presidential Council on National Competitiveness (PCNC) consisting of members from government, business, and academia. The PCNC holds meetings attended by the President on a monthly basis, in which he personally reviews the implementation status of the Council's agenda, allowing close and

continuous monitoring of task implementation. In January 2009, Korea formed the 47-member Presidential Council Nation Branding, a government initiative meant to coordinate all nation-branding efforts. It includes 8 ministers, numerous business leaders, and professors. The council has embarked on a ten-point “Brand Korea” action plan. However, the strategy seems to be focused more on the promotion of the cultural side of Korea, rather on placing the key competitive advantages of the country.

Other policies: Finally, the Lee Myung-bak administration is pushing for a broad environmental agenda geared towards sustainable development with a focus on clean renewable energy and environmentally friendly technology aimed not only to reduce the costs of production but also to combat climate change. Inaugurated in February 2009 the *Presidential Committee on Green Growth*, was designed to set economic and industrial policy directions in line with environmental preservation and sustainable development priorities. The committee promotes the creation of environment-friendly development and technology projects.

President Lee Myung-bak’s stated policy also favors deregulation. Like his predecessors, he is pushing for reforms through a myriad of committees set up under the top government officials. In May 2009 the Council on National Competitiveness short-listed 280 cases calling for respites or permanent improvements in regulatory enforcement, mainly in the areas of land and small-business regulations. The government is implementing the plan to merge or sell part or all of the operations of 41 state enterprises, including two development banks, continue to deregulate financial sector and thinking about privatizing giant government enterprises like Korea Rail.

5.1 INSTITUTIONS FOR COLLABORATION

Korea has a number of IFCs. From 1970 to 2007, the government and the private sector have promoted the development of a number of research centers and business associations to promote

business collaboration across various industries. For instance, the Federation of Korean Industries; the Korea Plant Industries Association (KOPIA); the Korean International Trade Association (KITA), and the Korea & America Scientists & Engineers Association (KSEA). Another influential group that promotes cooperation at the international level is the Korea Foundation for International Cooperation of Science & Technology (KYCOS).

6. KOREA-RECOMMENDATIONS

Since the 1960s Korea has increased its per capita GDP more quickly than any of its neighbors but still lagging behind its main competitors. Korea's economy has relied heavily on the success of its manufacturing sector lead by *Chaebols*, missing the opportunity to exploit more its service potential.

Our first recommendation for the country is to break the notion that economic growth only comes through *Chaebols*. Research by the McKinsey Global Institute (MGI) has found that over the past 25 years, nearly 85% of GDP growth in high-income developed countries came from services. If Korea wants to enhance its economic growth in the following years, it has to place greater emphasis on its labor-intensive services sector.

With respect the existing clusters, we believe that Korea will face greater competition from Taiwan, China and even Japan in the years ahead. We think that Korea's strategy must be to move higher up in the value chain. Capital investment and especially FDI will play a crucial role in that ascent. Korea must establish a new strategy to attract FDI to the country, ensuring property and intellectual rights, eliminating red tape and bureaucratic processes to investment, an fostering a true competition policy. FDI must be oriented to help Korea to exploit its true competitive advantages, technology, design and innovation, and to promote cultural change in corporate governance.

It is imperative for Korea to enhance its financial sector. It must work towards the consolidation of its banking sector, the development of new financial instruments and the increase of venture capital and private equity in business development; all of these without reducing the regulation of the system.

Korea's competitive position in R&D is a key factor for the success of the country. The government and the private sector must embrace the notion that its future success will rely less on the production of physical things and more on intangibles such as knowledge and patents.

Korea's decision to expand tax deductions for business investments in research and development must be oriented to target new growth areas based on its current competitive advantages, such as nanotechnology, green technologies, and biotechnology. Korea must create new venues to ensure the availability of local specialized research and training services to support business development and productivity growth.

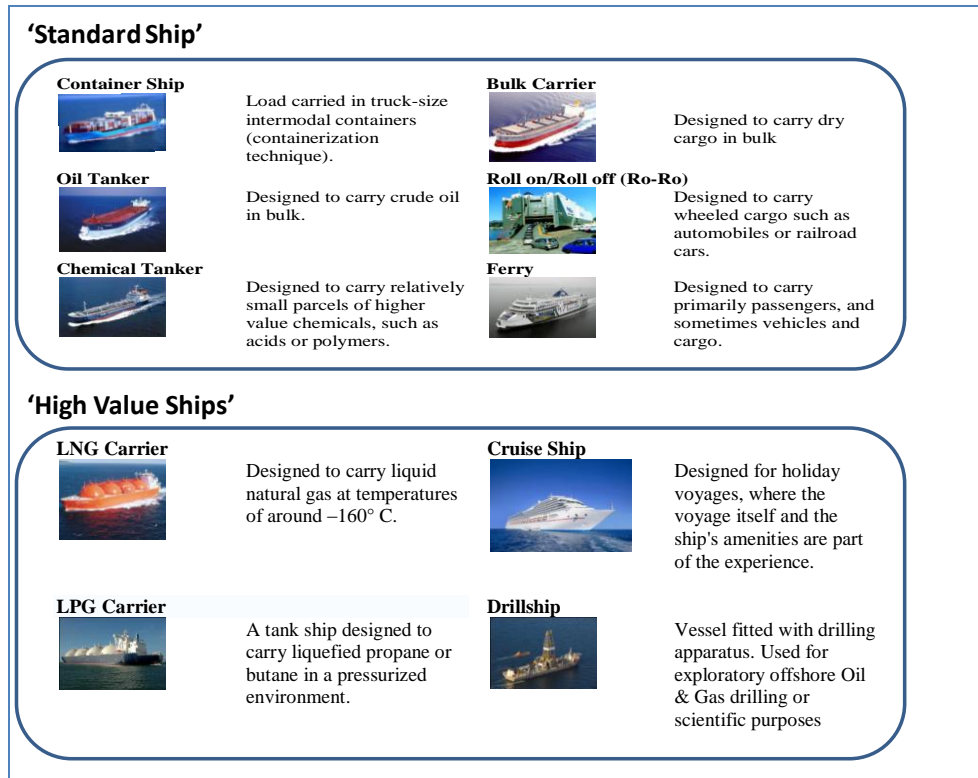
MGI has estimated that for Korea to reach Japan's current GDP per capita of \$37,000 by 2020, it has to grow at around 5.6% per year. With an aging population and low birth rate, Korea will likely have slower growth in its workforce in the years ahead, which makes even more crucial for the country to focus on increasing its labor productivity. To sustain its economic growth Korea's Parliament has to move fast in approving and implementing the labor reform to reduce its labor rigidity, high hiring and firing costs. The new labor framework must mandate more labor training in the private sector and foster the adoption of wage increases tied to productivity growth.

II. Cluster Analysis

1. SHIPBUILDING CLUSTER DEFINITION

In this paper, the Shipbuilding Cluster encompasses firms involved in the design and construction of oceangoing ships measuring 5,000 GT⁷ and above, in South Korea. The key segments ('Standard' and 'High Value') and portfolio of products are illustrated in Figure 8.

Figure 8



While the actual shipbuilding activity occurs in Korea's 7 Mega size and 8 Medium shipyards, the cluster depends on a variety of supporting and related industries that include steel fabrication, engine manufacturers plus a collection of specialized suppliers.

2. EVOLUTION OF SHIPBUILDING CLUSTER IN SOUTH KOREA

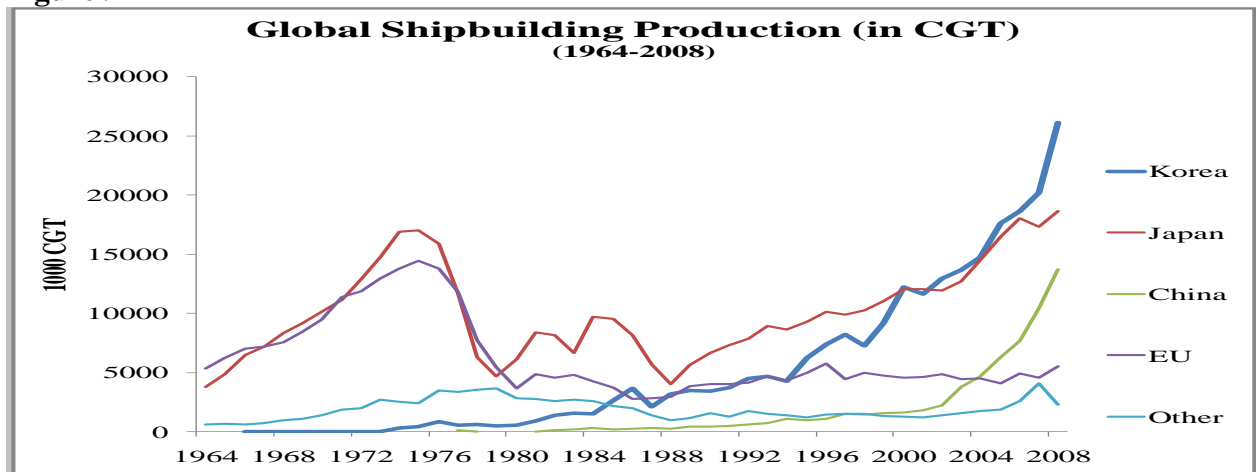
Korea's shipbuilding history can be traced to the 16th century but was inhibited by the self imposed period of isolation from 1637 until 1850,. The shipbuilding sector was revived with

⁷ Gross Tonnage is the total internal volume of the vessel per definition adopted by the Korean Shipbuilder's Association (KOSHIPA). In other parts of the document, data sourced from other external sources has been reported in CGT (ie. Compensated Gross Tonnage) comparative work content inherent in building the ship..

investments by Japanese companies in shipbuilding infrastructure during 1910-1945 invasions. After independence in 1948, the Government established the Korea Shipbuilding and Engineering Corporation (KESOC). The Government acted to allocate capital, expand facilities and facilitate imports of ship components.

The industry underwent significant growth since the early 70s as is illustrated in Figure 9 which tracks production outputs against its main competitors. From 1948 to 1972, Government policy shifted from ‘Trade’ to ‘Industrial’ focus (per 1st and 2nd Economic Plan), and leveraged the use of subsidies and import exemptions to stimulate the industry via selected *Chaebols*. Domestic demand was primarily for coastal cargo ships and fishery vessels, and the first 6000 GT oceangoing ship was successfully assembled in 1967⁸.

Figure 9



From 1970 to 1990, the industry focused on production efficiency and relied on imported foreign expertise. The establishment of the national steel manufacturer, POSCO and its relentless pursuit on production innovations against a backdrop of protectionism would evolve as a critical success factor. Focus on Research and Development (R&D) activities was stepped up with institutions like Korea Advanced Institute of Science & Technology

⁸ Hassink & Shin (2005)

(KAIST) in 1971 and increased collaboration between academia and industry via institutions such as Pohang University of Science & Technology (POSTECH) (1986). *Chaebols* started to embark on a series of strategic expansion activities – for example backward integration into ship engine suppliers and, in some case upstream into the maritime industry.

Since the 1990, the cluster started to benefit from agglomeration effects arising from a strong base of related and supporting industries, intense rivalry for global market share and R&D collaboration facilitated by industry associations. They also benefitted from a continuous supply of specialized engineering and vocational graduates. While the overall economy was affected during the 1998 Asian crisis, Korea's shipbuilding companies benefitted from the weakening Won recovered fairly fast (Figure 9). As the cluster is seeking to focus on moving up the value chain, the emergence of lower cost producing countries, particularly China is threatening their market share in the Standard Ship category.

3. CLUSTER PERFORMANCE & RELATIVE POSITIONING

South Korea is currently the leading shipbuilder in terms of production volume and sales as is illustrated in Figure D. South Korea's 'Big 3' producers, Hyundai Heavy Industries (HHI), Samsung Heavy Industries (SHI) and Daewoo Shipbuilding (DSB) currently dominate the global market in terms of output. In production terms, South Korea's output has increased by 63% between 1975 and 2008, and currently stands at 41% market share in terms of production value and 33% in terms of market value. At USD43.1 billion, the shipbuilding industry ranked first among Korean exports in 2008 for the first time in history, outpacing automobiles and semiconductors.

In terms of market value (Figure 10), South Korea illustrates a proportionately lower return on production than some of its competitors, in particular the EU countries. This is attributable

to their high reliance on lower end products (ie. Standard Ships) as opposed to the ‘High Value Ships’ segment as is illustrated in Figure 11.

Figure 10⁹
Global Shipbuilding Industry – Change in Market Share

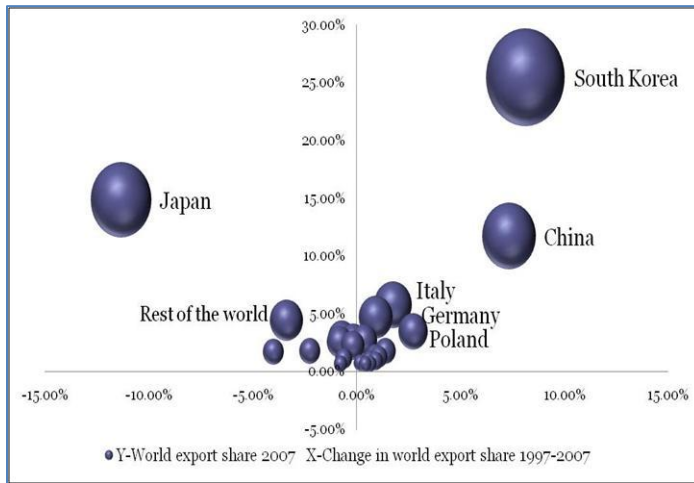
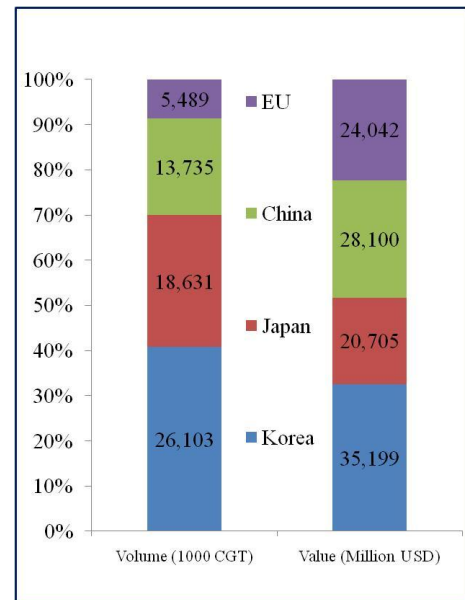


Figure 11¹⁰
Market Share – Volume (CGT) vs. Value (US\$)



The cruise ship product for instance (which is still dominated by EU countries) only accounts from 2% of production output but accounts for 20% of market value.¹¹ Despite its significant advancements in shipbuilding technology, South Korea has had some difficulties in breaking into the ‘High Value Ship’ segment as it faces intense competition in the Standard Ship segment (See Figure 12).

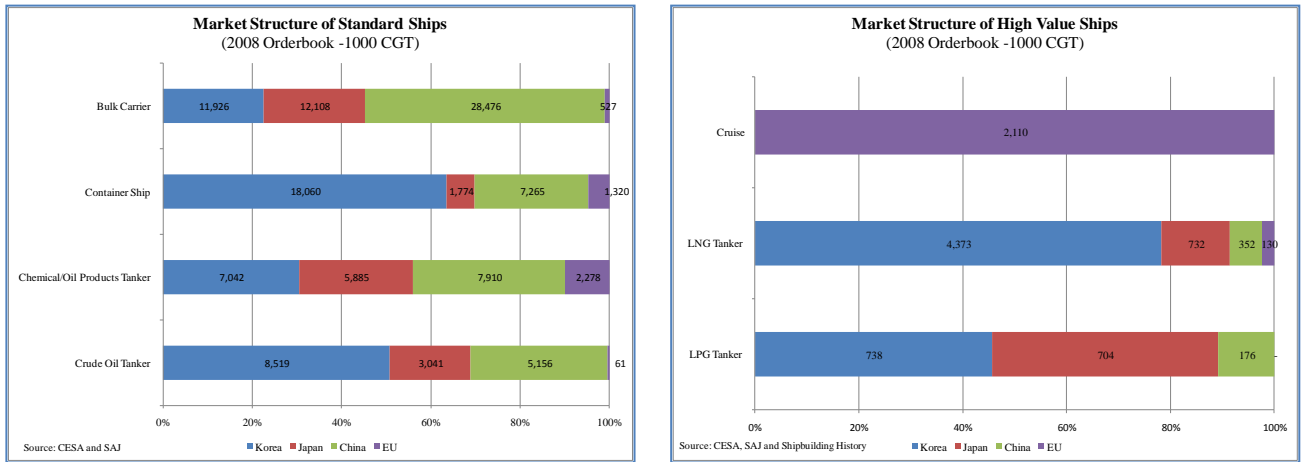
Korea’s shipbuilders are stepping up efforts on the High Value ship segment, with STX Offshore & Shipbuilding (STX) acquiring a stake in Aker Yards (of Norway) to penetrate this segment, while SHI has already announced plans to develop cruise ships.

⁹ Source : Institute for Strategy & Competitiveness

¹⁰ Source: Team analysis of data from Community of European Shipyards Association(CESA), KOSHIPA and ShipbuildingHistory.com

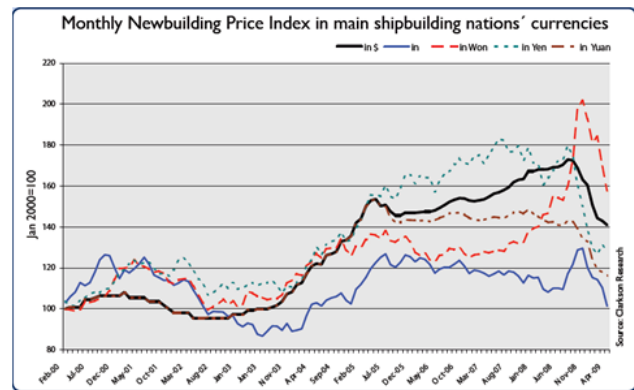
¹¹ Team analysis of CESA data

Figure 12¹²



Price competitiveness declining as labor costs increase and the strengthening of the Won, particularly from 2001 to 2007 (Figure 13). The value of a 1000GT of South Korea’s new ship order was \$1.5 million (2000) but in 2008 it had increased to \$3.4 million¹³.

Figure 13¹⁴



Productivity levels still holding up though wages have been on the upward trend, and South Korea appears to be still ahead of its competitors except China (see Figure 19, *post*)

Production Efficiency Not Innovation The industry has been driven by a relentless pursuit to outperform the ‘productivity frontier’¹⁵ to enhance operational efficiency. Highlights in 2008 include HHI’s ‘T-Shaped dock’ that enabled the simultaneous production of 2 ships and SHI’s 70% production automation rate. In parallel, there has been a focus on continuous

¹² Source : CESA, SAJ and Shipbuilding History

¹³ Team analysis of CESA data

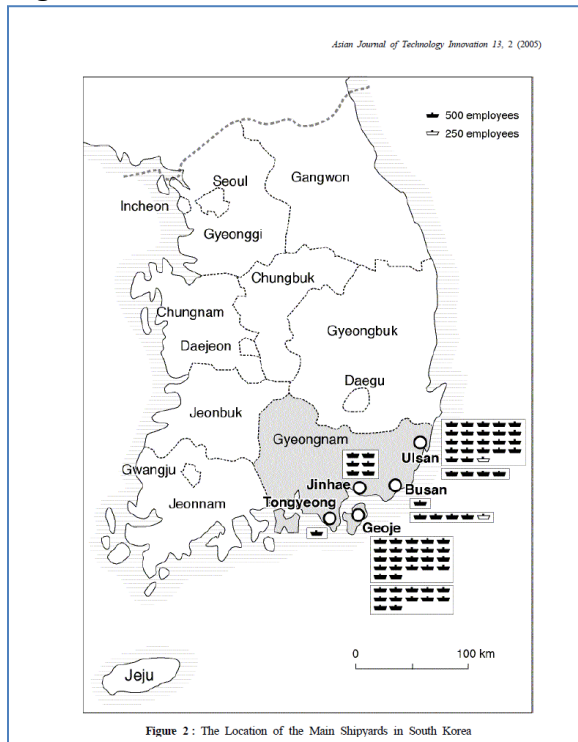
¹⁴ Source : CESA Analysis

¹⁵ Porter, M., E. (1998) On Competition

innovation to enhance its product portfolio highlights of which in 2009 includes the production of the world’s first multidirectional oil tanker and securing its first order for the first cruise ship to be built in Asia by Daewoo Shipbuilding & Marine Engineering (DSME). However as highlighted in country analysis (Figure 5 *ante*), in terms of innovation as measured by patents, they still lag most of their shipbuilding competitor nations, with the exception of China.

4. CLUSTER LOCATION & CLUSTER MAP

Figure 14¹⁶ - Cluster Location



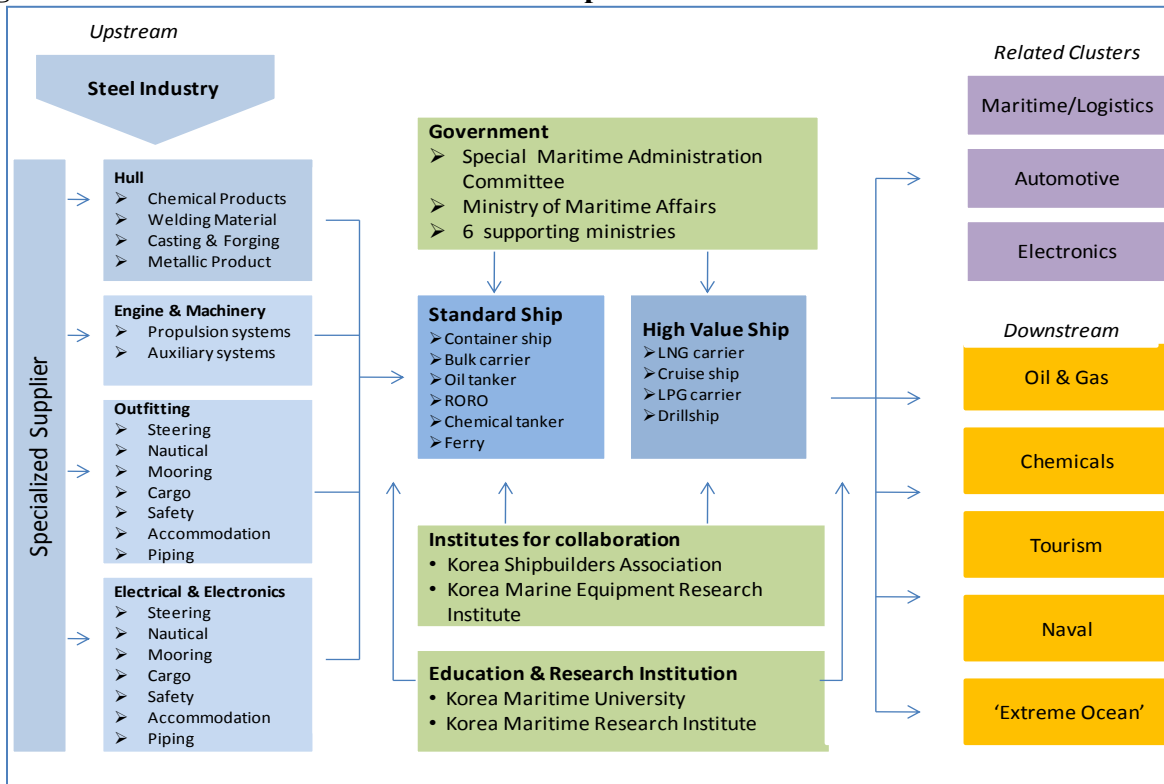
South Korea’s shipbuilding cluster is located in the region of Gyeongnam (Figure 14). Facilities of South Korea’s shipyards are located primarily in the Ulsan, Busan and Geoje districts. The deep waters and the lack of sandbanks made these districts natural choices for construction of shipyards. Its proximity to other heavy industries would over time contribute to agglomeration effects that the cluster benefitted from.

CLUSTER MAP (Figure 15)

Government The Special Maritime Administration Committee, chaired by the President himself and a dedicated Ministry of Maritime Affairs continue to support the cluster in light of its significant role to the economy.

¹⁶ Reproduced from analysis of Hassink & Shin (2005)

Figure 15 -South Korea’s Marine Cluster Map



Related Industries (Upstream) The steel industry plays a key role in raw material supply to the shipbuilding industry and its specialized suppliers. There are 10 major players in Korea, with POSCO accounting for roughly 60% of output). South Korea ranks as the 6th largest global supplier (53.6 million tons in 2008)¹⁷ and is highly regarded for innovations in production cost efficiency¹⁸. The cluster is also supported by a large ecosystem of specialized suppliers producing shipbuilding related components (Hull, Engine, Machinery and Electronics components) as well as Outfitting services. These 153 plus companies employ about 69,000 employees, with total revenues in 2003 of \$3.6 billion¹⁹.

Related Clusters The steel industry has been a catalyst for a number of other industries and in

¹⁷ US Dept. of Commerce, International Trade Administration Report (Apr 2010)

¹⁸ Shin & Ciccantelli. 2009 "The Steel & Shipbuilding Industries of South Korea"

¹⁹ Korea Marine Equipment Association website (<http://www.komarine.or.kr>)

the last 30 years, these industries have complemented each other in a virtuous cycle. Korea's automotive sector is currently fourth largest in the world in terms of production capacity²⁰, with Hyundai Motor Corp. as the leading player. Samsung is the largest Electronics company in the world, while LG has emerged as the 3rd largest cell phone maker in the world. The growth of its software and communications sector is expected to contribute to the increasing trend of digitalization in the shipbuilding sector²¹. These industries have also stimulated demand for automation technologies, benefitting shipbuilders like SHI where automation levels have reached 70% in 2008.

Related Industries (Downstream) Activities South Korea's maritime sector is a key end user of commercial ships for import of raw materials (in particular energy sources) and for export of its manufactured goods. Hanjin Shipping is Korea's largest carrier operating 200 vessels that transports in excess of 100 million tons cargo annually and 2008 revenues of \$7.7 billion. South Korea's ports play a key role in the economy, supporting international trade and logistics. Busan the country's largest seaport handles container traffic amounting to over 240 million tons²², making it the world's 5th largest port. South Korea completely depends on imports for oil consumption, and re-exports about a quarter of its gross oil imports as refined petroleum products, mostly to neighboring countries. In 2006, South Korea was the 9th-largest consumer of oil and the 5th-largest net importer of oil. The refining and retail sectors are dominated by several large Chaebols, with SK Corporation holding the largest market share. The Chemical industry accounted for 17.9% of South Korea's GDP (2008), with approximately 150,000 plus employees and 2007 revenues of \$152.3 billion. Leading companies in the sector are LG Chem

²⁰ Korea Automobile Association (<http://www.kama.or.kr>)

²¹ KOSHIPA Report 2008

²² Korea International Logistics Center (<http://www.kilc.org>)

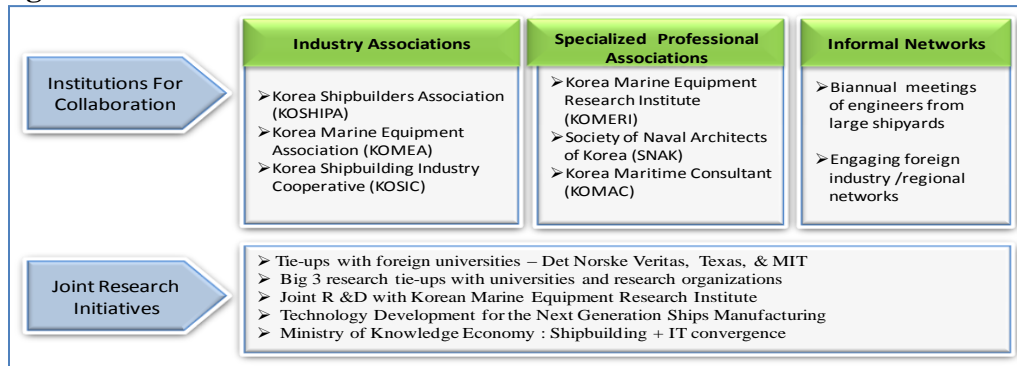
and Samsung Total Petrochemicals. The tourism sector²³ utilizes the ferry boat products produced by the cluster for purposes of domestic travel for mainland to island routes.

Educational Institutions Several key educational and research institution supporting the cluster including the Korea Maritime University (Busan) and the Korea Marine Equipment Research Institute (KOMERI) are located within the Gyeongnam region itself. The cluster also benefits from supply of Engineers from Seoul National University and Korea Advanced Institute of Science & Technology, KAIST, as well as skilled workers from vocational institutions such Ulsan Polytechnic College and Changwon Polytechnic College.

5. INSTITUTIONS FOR COLLABORATIONS (IFC)

Key IFCs supporting the shipbuilding cluster are illustrated Figure in 16. KOSHIPA is the leading shipbuilding association enhancing cooperation amongst members and promoting their common interests, with membership covering all major shipbuilders. Other key shipbuilding industry associations include Korea Marine Equipment Association (KOMEA) and the Korea Shipbuilding Industry Cooperative (KOSIC).

Figure 16



A host of specialized institutions such as the Korea Marine Equipment Research Institute (KOMERI) and the Society of Naval Architects of Korea (SNAK) are more focused on R&D activities and production innovation. The Government’s strong push to promote University-

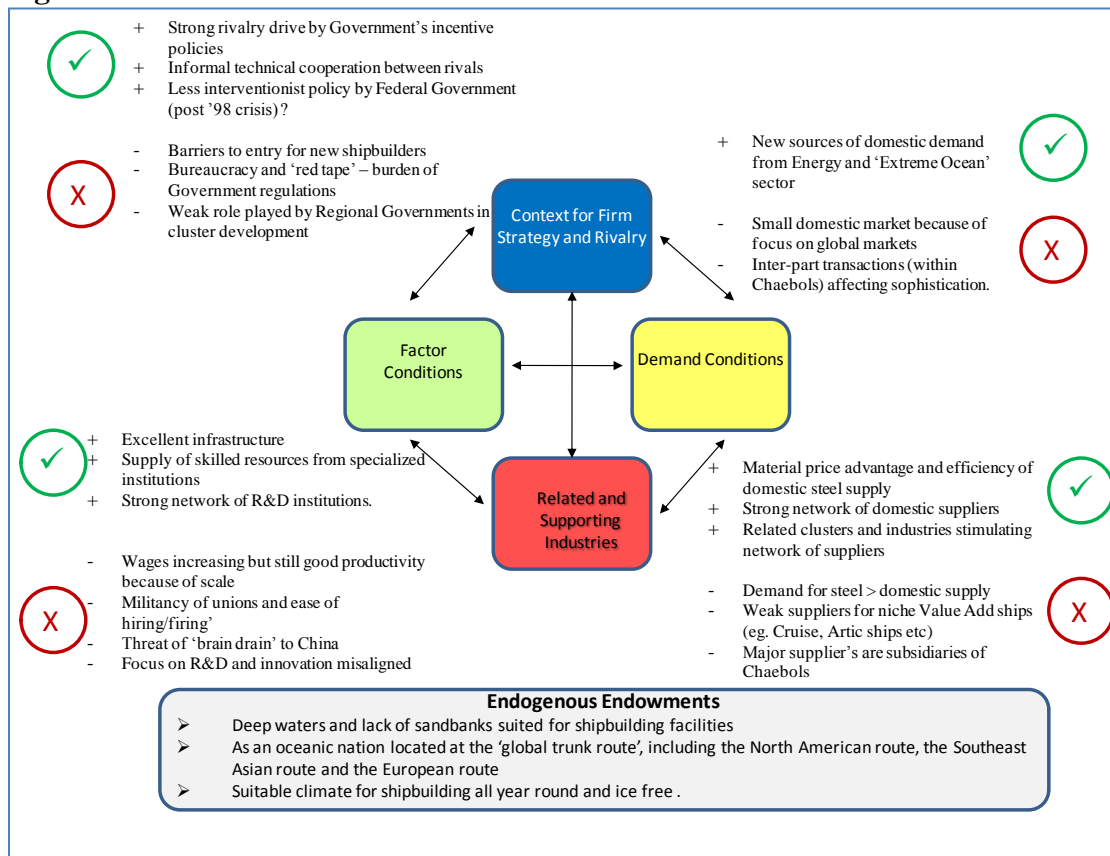
²³ Korea.net ‘Gateway to Korea’ (<http://www.korea.net/exploring.do?subcode=eng020009>)

Industry R&D activities in the 80s resulted in many collaborative initiatives, though outputs in terms of innovation have not been very encouraging. More recently the Ministry of Knowledge Economy, has been pushing for the convergence of shipbuilding and IT sectors to support the “Smart Ships” agenda.²⁴

6. CLUSTER DIAMOND

Shipbuilding diamond analysis is illustrated in Figure 17 with a summary of competitive advantages and challenges for the cluster.

Figure 17



Factor Conditions The cluster benefits from strong physical infrastructure in terms of modern shipyard facilities plus highly developed transportation logistics and communications infrastructure. Since the 1980s, the cluster has benefitted from agglomerations effects arising

²⁴ Ministry of Knowledge Economy presentation at OECD Workshop (Dec 2008)

from the development of industrial parks for collocation with suppliers and sub-contractors, and from a continuous supply of specialized resources from Universities & Vocational institutions with dedicated shipbuilding technology faculties. Wages have been on the upward trend (Figure 18), its productivity data is still ahead of its competitors at \$159 per CGT as illustrated in Figure 19, though there are some concerns about its labor market rankings. The Unions movement in is regarded as very influential and in some circles as being almost ‘militant’ towards management. While overall R& D spending at a country level has been increasing, R&D spending for the shipbuilding industry declined to just about 1% of total sale for the Big 3, which is lower than the average for Korea’s 538 listed companies (2.36%) or Samsung Electronics (9.4%)²⁵. University-Industry collaborations have also declined, which is likely to be attributable with the liberalization of the late 80s and skewing of institutional incentives to functionally specific goals²⁶. On the Industry side, evidence suggests that it does not necessarily share much of its R&D capabilities with academic and government entities, while the production of high quality outputs and patents still lag behind that of developed nations (Figure 5, *ante*).

Related & Supporting Industries. Production efficiency and competitive prices from domestic steel suppliers, has been reinforced by sophisticated demand from related clusters. In 2009 however, Korea’s imports of steel from China increased by 45.9%²⁷, which is quite alarming if this trend were to continue. Additionally, the strong network of specialized suppliers and sub-contracting resources are also a key asset though most of the successful suppliers are subsidiaries of the Chaebols (eg. Hyundai Heavy Machinery, the supplier of ship engines). South Korea’s shipbuilders are facing problems in sourcing for components for Value Add ships, in particular cruise and scientific ships which is somewhat connected to the issue of weak domestic demand.

²⁵ Asiasis (News Service for Asian Shipbuilding Industries) – 18 July 2008

²⁶ Park and Lydersoff (2009)

²⁷ US Dept. of Commerce, International Trade Administration Report (Apr 2010)

Figure 18²⁸

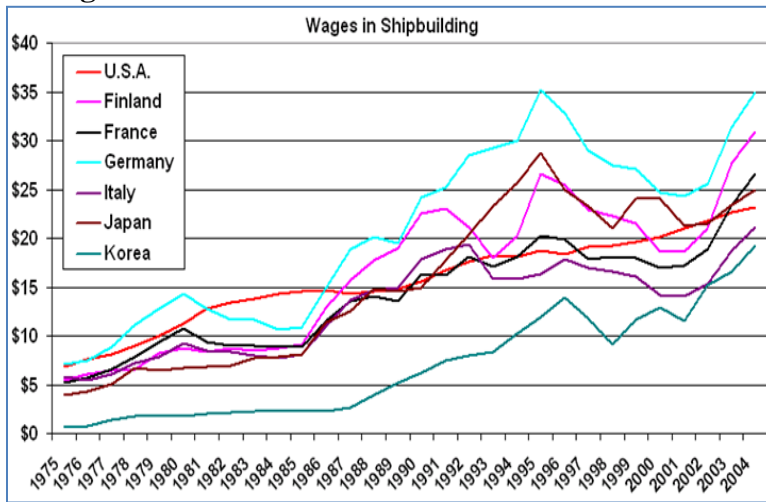


Figure 19²⁹

Country	Productivity (CGT per man-year)	Labor cost (\$ per CGT)
South Korea	145.1	159
Poland	42.3	182
Japan	182.7	202
Spain	90	336
Italy	57.5	622
Denmark	90.9	626
France	57.1	733
Germany	75.3	745
Netherlands	69.8	775
Finland	46.6	1164

Demand Conditions. Demand for the cluster’s products from the domestic markets (1989 to 2008) is very small (3.6%) when compared to its export market (96.4%)³⁰. The high demand³¹ for LNG carriers (in the mid to late 80s) to support its domestic energy needs was a key driver in becoming a market leader. Weak domestic demand sophistication for niche product like Cruise Ships will be a key issue for the industry as it seeks to transition to the ‘High Value Ship’ segment. New sources of domestic demand are however emerging from the energy sector, in particular ‘Extreme Ocean’ products such as tidal power plants and off-shore wind turbines.

Context for Firm Strategy & Rivalry The cluster is characterized by strong rivalry between shipbuilders driven by government’s historical incentive based policies. Government support has however always been understood to be conditional upon ‘performance’ and they have withdrawn support whenever performance has lagged³². Despite this strong rivalry, shipbuilder cooperate closely in 2 areas, with the first being in promoting common interests against external groups, as they did in EU deliberations on allegations of ‘anti-competitive’ behavior. The second is via an

²⁸ Source : Wages data (<http://www.shipbuildinghistory.com/world/statistics/wages.htm>)

²⁹ Stopford, M (2009), Maritime Economics. New York : Routledge (Based on 2005 data)

³⁰ Koshipa Statistics (http://www.koshipa.or.kr/eng/koshipa3statistics_kor.htm)

³¹ KOSHIPA -2009 Report (Preview)

³² Chang (1993) ; Fukuyama (1995)

informal network of Engineers from the largest shipbuilding companies who meet biannually to exchange technological information and in solving common problems³³. The cluster is however regarded as having high barriers to entry for new players, especially those that are seeking to move up the value chain, which is commonly attributed to the traditional stronghold by *Chaebols* on capital intensive industries like shipbuilding. In addition the cluster is also characterized by a high degree of red tape and bureaucracy as we saw from recent decision by STX Shipbuilding's to relocate its facilities to Dalian, China and Hanjin Shipbuilding's decision to move to a new facility at Subic Bay, Philippines.³⁴ Until very recently the Gyeongnam provincial government's role in the development of the shipbuilding cluster has been minimal, as the industry was perceived to be in the domain of the central Government and Chaebols. They therefore did not see it as being their role to develop the cluster.

7. RECOMMENDATIONS FOR THE SHIPBUILDING CLUSTER

Shift market focus and strategy Korea's position in the Standard Ship segment is not sustainable in light of the intense competition from China and other 'lower costs' new entrants (ie. Vietnam, Philippines and India). We are proposing a fundamental *strategic shift from 'manufacturing' to 'services' based operations* in this segment, and the relocation of its 'Standard Ship' product line as its traditional competitive advantages has been nullified³⁵. In light of improving bilateral relations with China, Korean shipbuilders should take advantage of the 'equity for technology' FDI incentives in China to increase strategic alliances with their shipbuilders. DSME, STX and SHI have already started making direct 'Greenfield' investment to operate Chinese hull block manufacturing sites³⁶ but the industry needs to start looking at a

³³ Hassink & Shin (2005)

³⁴ Olongapo City, SubicBay Zambales News (November 10, 2009)

³⁵ Porter, M.E. (1998). On Competition. Boston : Harvard Business School Press

³⁶ Doo Seok Kim (2009), 'Innovation Norway : Korea Maritime Industry Report'

broader and more structured initiative. Additionally this would negate the increasing trends of steel imports from China since the shipbuilders would be closer to raw material sources.

Stimulate domestic demand for ‘Value Add’ products After years of attempts to break into the Cruise ship market, DSME has finally secured its first order. Yet, despite 7.9 million inbound tourist and 11.9 million outbound tourists in 2009³⁷, to date there are no local Korean cruise ship operators. With majority of inbound tourist coming from Japan, China and United States³⁸ and its strategic location in the East Asian region coupled with the abundance of tourist attractions (including several world heritage sites), we believe there is significant potential to develop *the domestic cruise ship tourism segment* to stimulate domestic inbound tourism. This proposal would require cross functional inputs from other parts of Government and could help to stimulate demand for cruise ships. Korea’s high reliance on imported energy sources also build a compelling case for it to pioneer *extreme ocean technology segment*, in particular tidal power plants (currently being pioneered by Hyundai Samho Heavy Industries³⁹); off-shore wind turbines and carbon capture storage technologies. This would be a logical move up the value chain based on its established strengths across the maritime value chain segment. While there have been some company specific initiatives, this proposal would be best facilitated and coordinated under the Ministry of Knowledge Economy’s “Brain Korea 21” initiative.

Strong steering organization for coordinating R&D programs across institutional and disciplinary boundaries. In comparing the Japanese and Korean R&D accomplishments, it has been concluded⁴⁰ that Korea’s protective industrial policies encouraged the duplication of technological capabilities amongst major *Chaebols*, with a resulting failure to promote joint

³⁷ Korea Tourism Organisation (<http://kto.visitkorea.or.kr/>)

³⁸ Korea.net ‘Gateway to Korea’ (<http://www.korea.net/exploring.do?subcode=eng020009>)

³⁹ KOSHIPA Annual Report 2009

⁴⁰ Mariko Sakakibara & Dong-Sung Cho (2001), “Cooperative R&D in Japan and Korea: a comparison of industrial policy ”

R&D activities, primarily due to the organizational and institutional structure. Research policy should less based on strict quantitative performance measures but rather ” a balanced approach between bibliometric indices and the informed judgment of peers with expertise and academic maturity”⁴¹. While strong government control is neither desirable nor required, there is a need for the Government to facilitate the reformulation of research evaluation policies at a national and regional level to stimulate inter-organizational R&D activities that span institutional and disciplinary borders in areas such as the ‘Green Ship’ segment.

Decentralize cluster development role to the provincial government of Gyeongnam The cluster literature on the role of local governments to drive cluster development⁴² is especially relevant in the case of South Korea’s shipbuilding cluster. The developed status of Korea’s provincial governments and its proximity to the cluster participants and the challenges they face, warrants a decentralization of the central government’s role in driving the shipbuilding cluster. While the central government needs to adopt certain minimum standards (particularly in streamlining R&D policies at a national), provincial government of Gyeongnam can play a far more effective role in choosing public investment choices and driving implementation. For this cluster in particular, we see the potential for the provincial government to play a more significant role in reducing red tape inherent in government approvals, stimulating the participation of a local SME networks and attracting more national R&D establishments and professional associations located outside the cluster (particularly in Seoul and Daejeon⁴³) to relocate. The local government can also serves as a more effective a facilitator for company engagement with local union leaders, in reshaping a collective local work identity based on the founding values of the cluster.

⁴¹ Park & Leydesdorff (2009)

⁴² M.E., Porter (1998)

⁴³ Hassink & Shin (2005)

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European Community Shipyard Association (CESA) <http://www.cesa-shipbuilding.org>

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