THE EUROPEAN COMMUNITY

BACKGROUND REPORT

Overview of the international commercial shipbuilding industry

FIRST MARINE INTERNATIONAL LIMITED

May 2003

Background Report

CONTENTS

1 INTRODUCTION

1.1 Introduction

This report is intended to give an overview of the international commercial shipbuilding industry. The following subjects are included.

- Section 2 defines key terminology in common use in shipbuilding, in particular in relation to tonnage. Tonnage values are often confusing and the aim is to enable persons with a non-marine background to interpret statistics on the industry.
- Section 3 provides a classification and description of the main merchant ship types, describing key features.
- Section 4 provides a high level overview of the main features of the shipbuilding process.
- Section 5 places the prevailing market into historical perspective.
- Section 6 analyses product focus and market share for the main shipbuilding regions.
- Section 7 discusses the nature of ship ownership and the process of contracting for purchase of a new ship.
- Section 8 discusses the price of new ships and the issues surrounding the determination of price.

The commercial shipbuilding sector covers the main branch of the industry, building cargo and passenger ships for commercial operation. The other main sector, not considered in this report, covers naval ship construction. It is comparatively rare that the same shipbuilding facilities are used for both activities and the naval sector follows a different set of dynamics and economics. The comments and conclusions set out in this report apply largely to the commercial sector only.

1.2 First Marine International

First Marine International Limited (FMI) was formed in 1991 to provide specialist consultancy services to the marine industry. Principal clients include UK and overseas government departments and agencies, national and international maritime organisations as well as shipbuilders and ship repairers.

Our particular strength is our expertise and experience in all aspects of both shipbuilding and ship repair. We are well informed of the present European and world markets and the prospects to the end of the decade and beyond. We also have a comprehensive knowledge of industry best practice and can benchmark individual yards against these standards.

FMI has an experienced team of highly qualified consultants including shipbuilding, ship repair, shipping and marine equipment industry specialists. Members of this team have, collectively, worked on projects in over fifty countries and were first involved together in the 1970s in the design and engineering of the some of the largest and most successful shipyards in the world. Our expertise includes market research and forecasting; marine industry studies; benchmarking; competitiveness; technology development; upgrading of existing shipyards; design and engineering of greenfield shipyards; and development, implementation and management of shipyard performance improvement programmes.

1.3 Sources

Much of the information and opinion expressed in this report is based on First Marines research on the shipbuilding industry, conducted over many years. The statistics quoted are based on information from a number of background sources, the main ones being listed below.

- **Lloyd's Register of Ships.** Lloyd's Register (LR) provides the most complete database of the world's merchant fleet that is available. LR has maintained a listing of ships since the eighteenth century and the current database lists around 90,000 vessels, including ships on order as well as existing ships. All ships have to be registered with a national authority to be able to trade. Lloyd's Register includes a list of all registered ships and is regarded as the 'official' listing of the global fleet. This database has been used as the source of fleet and orderbook statistics. (It should be noted that the LR organisation also includes a classification society that provides quality assurance services to shipping and shipbuilding, amongst other industries, and a publishing company).

- **OECD working party on shipbuilding:** The OECD has maintained a shipbuilding working group for a number of decades. The aim of this group has largely been to work to achieve a level playing field in the shipbuilding industry and it has undertaken research in particular relating to capacity and price. The group publishes regular papers on the results of its research and statistics taken from these papers have been used in this document. References are provided in the text as necessary.

- **Clarkson Research Studies:** Clarkson Research is a subsidiary of London shipbroker, H Clarkson. The company provides statistics and publications on the shipping and shipbuilding industries and has a good reputation for the quality of data provided. Clarkson Research publishes a monthly guide to prices of the main ship types and this information is used widely in the industry, including by FMI.

- **Shipbuilders Associations:** Information provided by national representative bodies in the shipbuilding industries is used in background research. The principal associations concerned are the Shipbuilders Association of Japan, the Korean Shipbuilders Association and the Committee of European Shipbuilding Associations.

2 KEY TERMINOLOGY (TONNAGE AND CAPACITY)

Shipbuilding activity is generally quantified by reference to tonnage. This causes much confusion because there are several distinct measures of tonnage that are separately relevant to specific circumstances, most of which have nothing to do with the physical weight of the ship. The measures commonly encountered are defined and discussed below.

- **Gross tons (GT):** formerly known as 'gross registered tons', this is the fundamental measurement of the physical size of a ship. It refers to the volume enclosed by the ship's hull and superstructures in hundreds of cubic feet. 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. (The use of the word ton in this case refers to the old English word 'tun', meaning a barrel. The designation of 'tunnage' with reference to a ship was originally a measure of the capacity of a ship in terms of the number of barrels it can carry, hence its relation to volume rather than weight. The correct unit in this case is tons and not the metric tonnes).
- **Deadweight (dwt):** this measurement refers to the weight of cargo and consumables that a ship is designed to 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. Very large cruise ships, for example, are designed to carry low deadweight and appear small on a deadweight scale despite their size. It is the most appropriate parameter for specification of size of bulk cargo carriers, however, such as tankers or dry bulk carriers.
- **Compensated gross tons (CGT):** this measure refers to the comparative work content inherent in building the ship. It is based on the gross tonnage, which is modified by a compensation factor relating to the complexity of the building process. The CGT system was developed in the 1960s by the OECD in co-operation with the Association of West European Shipbuilders (AWES) and the Shipbuilders Association of Japan. The system was needed because gross tonnage alone is not adequate as an indicator of work content or capacity in shipbuilding. Relative work content varies by size and type of ship. One gross ton of a passenger ship, for example, with its sophisticated accommodation and public spaces, contains a significantly greater level of work content than one gross ton of a bulk carrier which is effectively little more than a large steel box with an engine on the back. One CGT of either ship on the other hand should contain roughly equivalent work content. The system has now been highly developed and is fundamental to the analysis of shipbuilding activity.
- **Steelweight:** the weight of steel contained within a ship's structure is often used by shipbuilders as a basis for performance metrics. The unit 'manhours per tonne', referring to a tonne of steel, is often used in production planning to measure work content. This measure is used only at the detailed operational level within shipyards.
- **Other tonnage measurements:** displacement tonnage is the total weight of the ship and its contents and is normally used only as a measure for military ships. Lightship weight is the total weight of a ship including structure, equipment and fittings, and is used primarily by naval architects for stability calculations. Net registered tonnage (NRT) is based on gross tonnage less certain allowances, and is used as a basis for calculating port and canal dues and other charges and taxes. It has no other use. These tonnages will not be used further in this report but may be encountered in other literature.
- **TEU:** standing for 'twenty-foot equivalent unit', is the key measurement of the cargo carrying capacity of a container ship. One TEU is the standard shipping container that can

be seen on the backs of trucks and train carriages, being a steel box with dimensions eight feet six inches square and twenty feet in length. Whilst there may be some variation within that space, for example possibly incorporating a tank for carrying liquids or a refrigerated space, the dimensions of the unit will not vary. Having said this, some routes and ships permit the use of a double-sized box at eight feet six inches square and forty feet in length. This may be referred to as one FEU or ‘forty foot equivalent unit’, or two TEU.

- **Cubic capacity:** certain ship types may have a size designated by the cubic capacity of the cargo it carries. Chief amongst this category are liquid gas carriers with size designated in cubic metres, equivalent to the volume of liquid gas they may carry.
- **Other measures:** specific ship types may have their capacity designated in the most appropriate units, for example in number of cars for a car transporter, in number of passengers for a cruise ship, or in number of animals for a livestock carrier.

3 THE MERCHANT FLEET

3.1 Overview

The merchant fleet makes up around 90,000 ships in total. In the main international commercial sectors these can be grouped into nine distinct types of ship, as described in table 3.1.

Ship type	Proportion of global orderbook at December 2002 (CGT)
Tanker	27%
Container ship	18%
Bulk carrier	15%
Chemical tanker	10%
LNG	10%
Cruise	6%
Roro	4%
LPG tanker	2%
Ferry	2%
Others	6%

Table 3.1 – Market classifications in the global shipbuilding market

Table 3.1 also shows the percentage of the total work content contained in the orderbook for each of these sectors at the end of 2002. Work content is expressed here using compensated gross tonnage values. It should be noted that the table does not provide an exhaustive list of ship types but includes the main elements of the international commercial market. The 'others' category listed above includes a wide range of ships, including more specialised types such as dredgers, cable layers and offshore vessels, as well as small ship types such as river barges and tugs.

The remainder of this chapter subdivides the fleet into three sections to aid the description of the market. These are:

- Bulk cargo carriers, including tankers, bulk carriers and container ships (60% of the current orderbook).
- Other cargo carrying ships, including chemical tankers, LPG tankers, Roro and Ferry (18% of the current orderbook).
- Niche sectors, including cruise ships, LNG carriers and specialised ship types (22% of the current orderbook).

Typical examples of each ship type are shown in photographs in appendix 1 of this report.

3.2 Bulk cargo carriers

The three main product types are as follows.

- **Tankers:** the use of the word tanker alone generally refers to oil tanker, carrying either crude oil or oil derivatives (normally referred to as 'oil products') such as petroleum, kerosene or naphtha. Generally speaking crude oil moves in large amounts in very large ships (above around 100,000 tonnes dwt) and products in smaller 'parcels' in smaller ships (up to around 70,000 tonnes dwt but typically in ships carrying up to around 45,000 tonnes).
- **Bulk Carriers:** normally refers to 'dry bulk' cargoes as opposed to tankers that carry 'wet bulk' cargoes. The major bulk cargoes, including coal, grain and iron ore, generally move in large quantities up to around 170,000 tonnes. Minor bulk cargoes, including for example animal feed or bulk sugar, are typically transported in ships carrying up to around 50,000 tonnes.
- **Container ships:** carry containerised cargoes, sometimes referred to as 'unitised' cargoes. There are a wide range of sizes of ships on a wide range of routes, typically following an established 'hub and feeder' pattern. Very large ships (the largest of which now rival the largest category of tankers in terms of physical dimensions) carry boxes on trans-oceanic routes serving the main hub ports in the Far East, Europe, North America and Middle East. Smaller 'feeder' ships then distribute the boxes from the main hub ports to local ports. The contents of the boxes are made up of 'general cargo', and may include such diverse items as machinery, white goods, clothing, electronic equipment, and so on.

The above three ship types make up by far the largest portion of the fleet and a significant proportion of the output from the shipbuilding industry. These main volume products are normally further sub-divided into distinct sub-classes, as described in table 3.2. The main ship types and sub types listed in this table are according to common industry usage and the terminology used will be found in any documentation relating to the fleet. The main ship type is defined by the function of the ship and the sup types are defined by size classifications demanded by operators of the ship. The sub-classifications have been developed to suit the economic conditions of the main trades in each sector and can largely be regarded as standard products. There is little material difference in operational terms between different ships within any class of sub-type, whoever the supplier may be. It should be noted that the economic classes of ship represented by the sub-types listed below are not readily substitutable for other ship types. For example it may be technically possible to adapt a bulk carrier to carry containers but in operational terms this would be unfeasible. Similarly, substitution is rarely possible on a size basis because of the economics of trade. One seventy thousand dwt ship, for example, is not operationally or economically equivalent to two thirty-five thousand dwt ships.

Main type	Sub-type	Summary
Tanker	ULCC / VLCC	Standing for 'Ultra-Large Crude Carrier' and 'Very Large Crude Carrier' referring to tankers carrying above around 200,000 tonnes of cargo. ULCCs over about 400,000 dwt are relatively rare and the typical size of a VLCC is around 300,000 tonnes dwt.
	Suezmax	Referring to the largest tanker that can transit the Suez Canal fully laden, being around 150,000 tonnes dwt.
	Aframax	AFRA stands for 'American Freight Rate Association'. This term has become the standard designation of smaller crude oil tankers, typically around 115,000 tonnes dwt.
	Panamax	Panamax refers to the maximum size of ship that can transit the panama canal, with a width restriction of 32.2m. This is a relatively new class in the products tanker fleet (panamax is traditionally a dry bulk ship classification) with a size typically around 70,000 tonnes dwt.
	Handysize / Handymax	Typical products tankers are between around 35,000 dwt and 45,000 dwt. The designation 'handysize' is taken from a similar ship size in the dry bulk fleet (see below).
Bulk carrier	Capesize	Referring to ships that are too large to transit the Panama Canal and therefore have to route around Cape Horn. These ships carry major bulk cargoes on long haul routes and are typically around 170,000 tonnes dwt.
	Panamax	The maximum size of ship that can transit the Panama Canal, within the 32.2m width limit. The typical size is around 70,000 tonnes dwt.
	Handysize / Handymax	This is the predominant sector of the dry bulk fleet with ships typically between around 35,000 tonnes dwt and 45,000 tonnes dwt. This class of ship has typically been the 'workhorse' of the dry bulk trades and thus earned the designation 'handysize'. The size of ships in this category has been gradually increasing over the past ten years, hence the relatively recent term handymax, designating a ship larger than traditional handysize. Handymax has no specific limit, as is the case for panamax and suezmax for example.
Container	Post-panamax	Referring to container ships that are too large to transit the Panama Canal. This class of ship tends to work on trans-oceanic routes and the largest ships now rival VLCC tankers in terms of physical dimensions. The size range is typically around 5,500 TEU (i.e. capacity to carry 5,500 containers) up to over 8,000 TEU. The maximum size of ship is continuously increasing.
	Panamax	The largest ship that can transit the Panama Canal, typically between 3,000 and 4,500 TEU.
	Feeder	There is no particular sub-class below panamax size with a very wide range of ships to serve a huge number of routes. The smallest may measure only a few hundred TEU.

Table 3.2 – Characteristics of volume ship types

3.3 Other cargo-carrying ship types

Unlike the volume market sectors there are fewer distinct classes of ships within the other main types. The main products are described below.

- **Chemical tankers:** designed to carry relatively small parcels of higher value chemicals, such as acids or polymers. Ships are typically relatively small, up to around 25,000 dwt. Chemical tankers are classed according to categories dictated by the International Maritime Organisation (IMO) that classes chemicals according to the level of hazard they represent. IMO class I represents the greatest hazard and requires ships with sophisticated tanks and cargo handling systems, often manufactured from stainless steel. IMO class II represents a lower class of hazard with relatively normal tanks and cargo handling systems. IMO class III refers to low hazard chemicals, such as many petroleum products. There is a blurring of the distinction between products and chemical tankers for these lower classifications. (Lloyd's Register's classification 'chemical/products carrier' normally refers to a products tanker rather than a chemical tanker).
- **LPG tankers:** designed to carry liquefied propane or butane under pressure, with typical sizes up to around 25,000 dwt. The level of sophistication in the cargo containment system is relatively high compared to crude oil or petroleum products tankers, but is far below the complexity of an LNG (methane) carrier (see below).
- **Roro:** an acronym standing for 'roll-on-roll-off', referring to the method of loading the cargo on wheeled vehicles or trailers via ramps that lower onto the quayside. Sub types include dedicated vehicle carriers for transport of cars and other vehicles from the manufacturer to the distributor. Such ships can be large and there is no typical size. The characteristics of this ship type are large cargo volume and multiple internal decks. The complexity in building largely arises out of the complexity of the structure, the thin nature of the plate from which the ships are fabricated and sophisticated hydraulic ramps and other cargo loading systems.
- **Ferry:** designed for transporting passengers and often vehicles in addition, the market divides into three main groups. Roll-on-roll-off (roro) ferries tend to be large ships, often operating on relatively short routes such as across the English Channel or the between Greek islands. A new generation of ships is emerging for longer routes, known as cruise-ferries, that offer a higher standard of passenger accommodation and some of the facilities offered by cruise ships. Finally there are fast ferries that tend to be smaller, may have multiple hulls (catamarans) and are often built from aluminium rather than steel.

3.4 Niche ship types

Construction of niche ship types is restricted to a small number of builders. Entry costs are very high due to high capital costs and a high cost of technology development to meet the demands of these most technologically sophisticated of ship types. The main products are described as follows:

- **Cruise:** the characteristics that mark cruise ships out from other market sectors are the complexity of the product (arguably, along with major warships, these are the most complex products produced by any industry) and the standard of finish required. The size of ships has been increasing over time and the Queen Mary II, currently under construction in France, will be the largest passenger ship ever built at around 140,000 GT. To put this into perspective the Titanic had a GT of around 30,000 tons and a typical modern cruise ship has a GT of around 75,000 tons. The construction has a cycle time measured in years, rather than in months as is the case for bulk ship types, and much of the work involved in construction is related to fitting of public spaces aboard the ship and the complex systems for running the vessel.

- **LNG:** liquid natural gas (methane) is carried at temperatures of around –160° C and as such presents very significant technical difficulties in the design of the cargo containment system. The ships are large and the potential hazard represented by the cargo (an explosion of one of these ships would represent a blast of several mega-tonnes) dictates that the standards of construction are higher than any other class of ship. Construction is restricted to a small number of licensed builders and entry costs into this sector are very high. Two containment systems have been developed. The original system uses spherical tanks and is based on a design by Moss Rosenberg. These ships are often called ‘Moss type’ or ‘spherical type’. The alternative system uses more conventionally shaped tanks based on designs by Gaz Transport or Technigaz, normally referred to as ‘membrane type’. Further details of the two systems are given in the photographs in appendix 1 of this document.

3.5 Small shipbuilding

In addition to the above a note has to be made about the remainder of the market, predominantly classed as short sea and small specialised ships. Whilst the normal view of the shipbuilding market is that it is global with the geographical separation of supply and demand having little influence, the market does in fact divide into two at around 5,000 tonnes dwt. Below that size is a complex sub-sector of the market including a range of cargo ships (normally referred to as short-sea tonnage because of geographical operating restrictions on such small ships) and small specialised ships such as tugs, fishing boats and workboats. This market is more geographically restricted than the larger ‘deep sea’ sectors, and domestic or regional building is a strong feature. This is because of the disproportionately high cost of contract management and supervision for a small ship when built at a distance. Beyond mentioning here, this sub-sector is regarded as outside the scope of this discussion. The total volume of the market is very small (around 6% of the total market expressed in CGT) when compared to the international markets discussed above.

4 OVERVIEW OF THE SHIPBUILDING PROCESS

The hulls of the vast majority of commercial ships are constructed from steel. A small number of specialised types (notably some fast ferries) are built from aluminium. Composites (fibre or glass reinforced plastic) are very rarely used in commercial ship construction.

Shipbuilding can broadly be classed as an assembly industry. The traditional view of the process is that it divides into two parts:

- Steelwork – the pre-fabrication, assembly and erection of the steel structure of the ship;
- Outfit – the installation of the systems, equipment and fittings into the ship.

Traditionally the two parts of the process were undertaken sequentially, with outfitting starting once the steel structure had been finished. Increasingly since the 1960s the two stages have been undertaken as far as possible in parallel to improve efficiency. This is illustrated in the photographs in Appendix 2 of this report, illustrating some of the processes involved in the construction of a typical ship.

The basic unit of the ship's structure is a steel panel constructed from plate to which steel bars are welded to give adequate stiffness. The majority of panels in a ship will be flat but a proportion has to be shaped in two or three dimensions to provide curves. Steel plates and bars are cut to a pre-determined shape prior to fabrication, with the cutting process being automated in a modern shipyard. Much of the flat panel production can also be automated using 'panel assembly lines' that require little human intervention to produce large quantities of fabricated steel.

Flat and curved panels are joined together to form three-dimensional steel assemblies. As much outfit equipment and fittings as possible are incorporated into these assemblies at the earliest stage since the cost of outfitting increases significantly as the shipbuilding process proceeds. Assemblies may be further blocked together before final erection in the building dock or on the building berth (also referred to as 'slipway'). Most leading shipbuilders now build in docks. The limit on the size of block that can be erected is determined by the capacity of the dock or berth cranage. Fundamentally, the larger the block that can be erected at this stage, the more efficient the shipyard can potentially be.

One of the key bottlenecks in the shipbuilding process is the capacity for painting. Traditionally this was the last activity undertaken after all other work had been completed. As with other processes, painting is now undertaken at an early stage and as much as possible is completed prior to erection of the blocks. Ideally, painting should be undertaken in controlled conditions to minimise the curing time of the paint. Shipbuilders have made significant investment in recent years in painting facilities to improve quality and reduce waiting time for paint to cure.

The steel and outfitting work on the ship will be completed as far as is practical in the dock before the dock is flooded and the ship floated out: the modern equivalent of launching from an inclined slipway. After float-out, the systems will be commissioned and tested and the ship will complete a series of trials before delivery.

The cycle time for production depends on the efficiency of the shipyard and the product concerned. The typical production period for a bulk cargo ship may be of the order of six to nine months and for a cruise or LNG ship up to two years or more.

Whilst it has been possible to automate some shipbuilding processes, in particular at early stages of production, shipbuilding remains a relatively highly skilled enterprise. It also remains labour intensive with the number of manhours required for the production of a ship typically being of the order of 0.3 to 1.5 million. The major skills used include steelworker, welder, pipeworker, mechanical fitter, electrician, sheetmetal worker and joiner/outfitter. The shipyard is likely to carry most of these skills itself but a proportion of the production work will be subcontracted to specialist companies. Typically, subcontracting will cover installation of air conditioning, hydraulic systems and painting.

The balance of skills, in particular between steelworking and outfitting trades, varies by type of ship. The characteristics of the shipbuilding facilities also vary by type and size of ship. For example, a shipyard set up to series-build tankers, with high volume throughput and a predominance of steelwork, will be less efficient at building niche ship types with a high outfit work content and low throughput. This is not to say that such ships can not be built in the same facilities but it may be difficult to achieve this mix economically without significant investment to avoid disruption to the main production flow.

In addition to the production capabilities of a shipyard (incorporating the characteristics of physical facilities and the balance of workforce skills), management and organisational skills are of paramount importance in the shipbuilding process. A typical ship will involve the assembly of millions of parts and the logistical skill of a yard in planning work and controlling material flow is one of the keys to its effectiveness. Design skills are also a key to efficiency. Design at all levels of detail can have a major effect on the efficiency of the production process, as well as the operational efficiency of the finished ship.

Finally it should be noted that the ‘smoke-stack’ and ‘sun set’ labels that are often applied to shipbuilding in the popular press are misleading. The products of the industry are amongst the most technologically sophisticated produced by any industry. The modern shipbuilding process is also extremely sophisticated and modern shipyards are highly efficient industrial enterprises requiring extremely competent management. The image of the industry as providing dirty jobs in unpleasant conditions has been superseded in much of the industry, although it persists in some sectors and some countries.

5 THE HISTORICAL MARKET PERSPECTIVE

5.1 Development of demand

In order to understand the current position of the shipbuilding industry it is necessary to understand the development of the industry in the late 20th century. Figure 5.1 presents a graph of the output from the global shipbuilding industry, in gross tons, between 1960 and 2002.

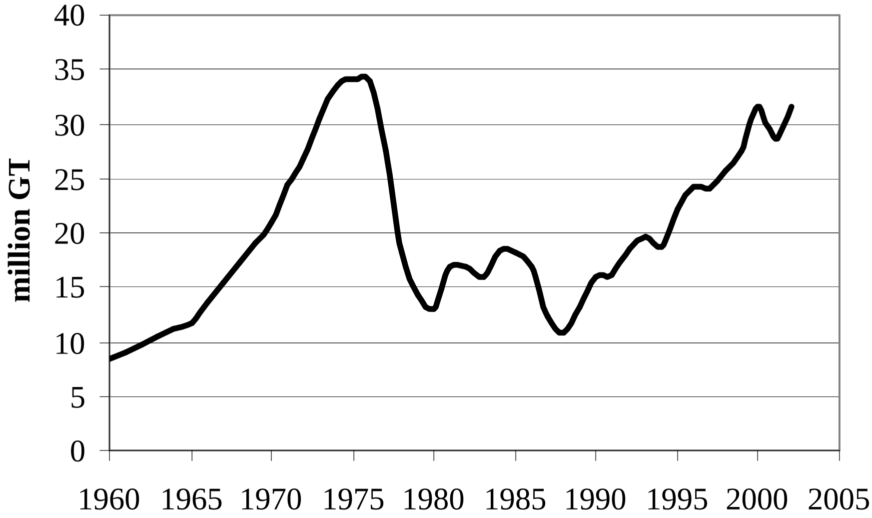

Figure 5.1 – Global shipbuilding output since 1960 (million GT)

The key points in the development of the industry can be summarised as follows.

- **1960 to 1975:** during this period shipbuilding was a high growth industry. Output trebled to a peak of almost 35 million GT in 1975, a level subsequently unequalled. Investment was high in new facilities and new shipbuilding technologies and capacity expanded globally. It was during this period that the government of South Korea chose shipbuilding as part of the 'economic engine' to help to take that country's economy from an agrarian to an industrial basis. The establishment of the industry in South Korea effectively commenced in the first half of the 1970s.
- **1975 to 1980:** the peak of 1975 was followed by a collapse in demand, with output halving within three years. This collapse is normally attributed to the oil crisis of 1973 and the effect that this had on the demand for oil tankers. It is likely, however, that a collapse was inevitable following a market that was overheated. The collapse brought with it a slump in prices due to over-capacity and led directly to the regime of subsidies and rationalisation that has dogged the industry since that time.
- **1980 to 1990:** the 1980s were characterised by sustained low output at around half the peak level. This was accompanied by extensive rationalisation of capacity in Europe and Japan, although over-capacity persisted. The reasons for the maintenance of uneconomic capacity in the face of reduced demand can be summarised as follows.

    1. Sunk cost: shipyards represent high capital investment and it is difficult to write this investment off.

2. High employment: shipyards tend to employ relatively large numbers of persons and have a high economic multiplier effect. It has been estimated that for every one job directly in the shipyard, between three and five other jobs are supported outside the yard.
3. Market forecasting: with an average life expectancy of between 20 and 25 years an upturn in shipbuilding in the 1990s, between 20 and 25 years after the previous boom, had long been predicted. Shipyards sought to hold on until the upturn arrived, expecting a return to economic fortune.
4. Strategic considerations: the ability to build ships is regarded by some as a necessary skill for the long-term defence capability of a country.

- **1990 onwards:** the long-forecast upturn in the industry has materialised as expected and since 1990 shipbuilding has again been a high-growth industry. What hadn't been expected was that the upturn in demand has not been accompanied by an upturn in economic fortunes for the world's shipbuilding industry. The reasons for this are linked to the development of capacity and price, discussed in more detail below.

The upturn in demand since 1990 has not been solely due to the need to replace obsolete ships built in the 1970s. The vast majority of goods transported over long distances are transported by sea and ships are unlikely to be superseded in this role for the foreseeable future. World trade continues to expand and the fleet needs to expand to accommodate this. There have also been a number of particular developments in the past decade, in particular in containerisation, the expansion of the cruise holiday market and the expansion in use of LNG as a fuel source. These factors have led to a significant demand for new ships in these categories. Regulatory developments also have a significant influence on demand. The requirement for tankers to meet higher standards of pollution prevention following a number of much-publicised disasters, for example, has led to an increase in the production of ships designed to take the place of tonnage to be phased out because it no longer meets the regulatory standard.

There is no consensus amongst forecasters as to where the industry will go next. Some (a minority), expect output to increase from present levels. Others anticipate that output is currently at a peak and will fall from the current level. The author's own forecast suggests that output will fall to a sustainable level of between around 20 and 25 million GT per year, lower than the current peak but well above the very low levels seen in the 1980s.

5.2 Development of capacity and the effect on price

As discussed above, it had been anticipated that the recovery of demand in the 1990s should have been accompanied by a return to profitability in shipbuilding. The key to this anticipated recovery was an expected increase in price resulting from an increasing volume of orders. This expectation was based on the traditional 'commodity' view of shipbuilding prices, discussed in detail in section 8 of this report. The basic expectation was that shipbuilding prices should rise and fall in line with demand, as happens with any commodity. In reality this relationship is sensitive to developments in shipbuilding capacity and prices have fallen significantly over the 1990s as capacity has expanded, despite a significant growth in output.

The measurement of capacity in shipbuilding is fraught with difficulty and is generally subjective. No definitive assessment has been successfully produced and, indeed, it is doubtful that such a thing would be possible.

The main influences on capacity are as follows.

- **Facilities:** the extent and nature of physical facilities will clearly have a direct bearing on the available capacity. This includes the area of workshops, the availability and capacity of cranes and, above all, the building facilities. Modern shipyards construct ships in dry docks (also known as "building docks") to be floated out on completion, rather than the traditional system of launching from a slipway. Building docks may be very large, permitting the construction of a number of ships side by side and end to end. Such docks are costly to build, however, and the availability of capital may limit the ultimate capacity of a shipyard. Building on slipways or building in a restricted drydock places capacity restrictions on the entire shipyard.
- **Productivity:** the capacity of the physical facilities will be limited by the efficiency with which they are operated. Productivity is to some degree determined by equipment but is more to do with organisation and operating systems and the way in which the facilities are managed. The planning of the production process and the details of design have a major influence on the level of performance and thereby the output that a shipyard can achieve.
- **Workforce:** the facility, however large, can only turn out work in relation to the size and skill of its labour force. The number of persons employed by the builder will often be the limiting factor on the output of a facility.

Because of the complexity of the determining factors, it is impossible to put a definitive figure on global shipbuilding capacity. Most estimates are based on output, rather than capacity. In 2001, OECD estimated global capacity to be around 23 million CGT for the year 2000, anticipating this to increase to 27 million CGT by 2005 (note: capacity inevitably increases as shipbuilding performance increases, in addition to increases due to new investment). This compares to actual output in 2000 of 20.4 million CGT, suggesting a level of over-capacity of 13.5% at that time. The distribution of this estimated capacity was as follows:

Shipbuilder	Estimated capacity in 2000 (CGT 000's)
Japan	7,160
South Korea	6,455
Western Europe (EU countries plus Poland and Norway)	5,165
China	1,425
Others	945

Table 5.1 – OECD estimate of global shipbuilding capacity in 2000

The reader is referred to the OECD Working Party on Shipbuilding report "Evaluation of World Shipbuilding Capacity (2000 revision)", 29 May 2001, C/WP6(2001)6 for further discussion of this estimate and the development of capacity.

The ill effects of overcapacity have long been known in shipbuilding and the control of capacity was at the core of the restructuring of the industry in the 1980s in both Europe and Japan. Within the EU, shipbuilding subsidy directives permitted subsidy to shipbuilding whilst at the same time restricting capacity. No capacity development was permitted and over the 1980s and large scale closures and job reductions were seen throughout Europe. In Japan the rationalisation programme also saw a major reduction in the workforce and rationalisation of shipyards. In addition to this the

Japanese government controlled the rate of intake of new orders to stop any tendency towards capacity expansion as order volume improved. These measures were aimed specifically at trying to ensure that, once the market had recovered, the industry globally could return to normal economic conditions.

The results of these measures were that by the end of the 1980s shipbuilding prices had improved considerably. This can be seen clearly in figure 5.2, which presents an index of newbuilding prices between 1988 and 2003.

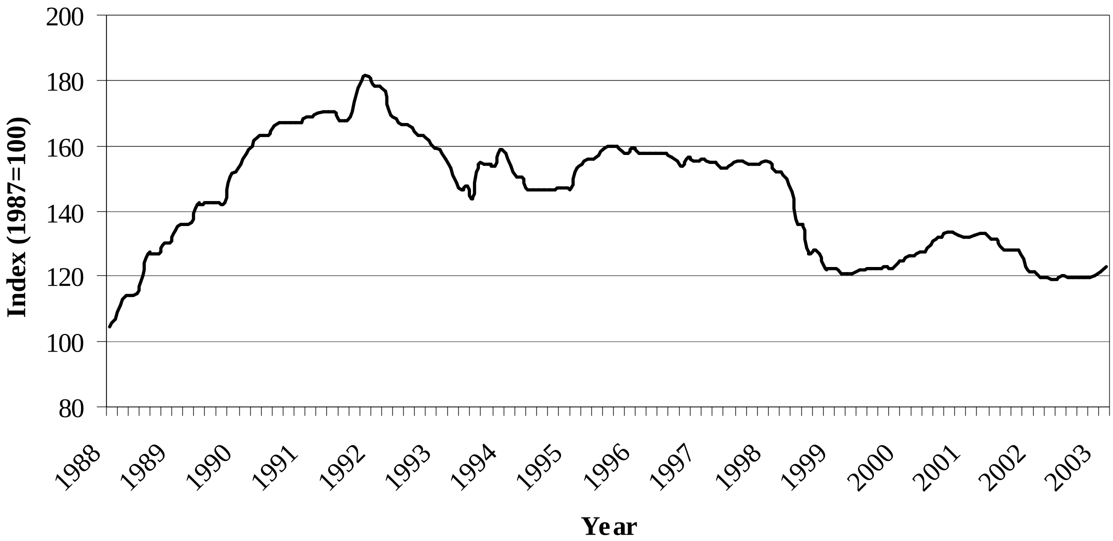

Figure 5.2 – FMI newbuilding price index

By the end of 1991 prices had reached a level whereby the newbuilding price subsidy permitted within the EU could be phased out and the OECD was making good progress towards an agreement on the global elimination of subsidies in shipbuilding. What hadn't been anticipated was that prices would fall over the 1990s, even as volume increased rapidly: between 1991 and 2000 prices fell on average by one third.

The cause of this deterioration in prices is laid firmly at the door of capacity expansion. It is true to say that expansion has taken place in a number of countries around the world. Recently, China has been expanding its industry through significant investment and a number of Eastern European shipyards have been re-activated through inward investment. Both these developments, however, came long after the expansion that caused the price falls of the early 1990s. The main cause of expansion at that time was investment in capacity in South Korea in anticipation of the upturn in the market. New shipyards were built over this period and existing facilities expanded. In addition to this, Japan was able to bring back on line capacity that had been restricted through order regulation, but that had not physically been eliminated.

6 DEVELOPMENT OF MARKET SHARE AND PRODUCT FOCUS

6.1 Overview

The following tables show the distribution of new orders reported in the main shipbuilding regions over the past five years, giving the average quarterly order intake by CGT in Table 6.1 and the share of the total in Table 6.2.

Year	China	EU	Japan	South Korea	Rest of World	Total
1998	164,750	1,109,000	1,556,250	1,170,500	699,500	4,700,000
1999	481,000	716,500	1,233,750	1,581,500	737,250	4,750,000
2000	495,000	1,252,500	1,921,500	2,640,000	1,066,000	7,375,000
2001	664,000	714,250	1,941,000	1,772,250	733,500	5,825,000
2002	667,250	361,750	1,868,500	1,415,750	804,500	5,117,750

Table 6.1 – Average quarterly generation of new orders (CGT)

Year	China	EU	Japan	South Korea	Rest of World
1998	4%	24%	33%	25%	15%
1999	10%	15%	26%	33%	16%
2000	7%	17%	26%	36%	14%
2001	11%	12%	33%	30%	13%
2002	13%	7%	37%	28%	16%

Table 6.2 – Development of market share (% of new orders won by CGT)

Appendix 3 to this report presents details of the development of market share over this period by ship type and builder country. It also presents statistics to show the product sectors focused on by each country or region. These aspects are discussed in detail in the following sub-sections.

6.2 China

China has seen order intake rise steadily over the past five years, achieving a share of 13% by 2002. This has been in line with the plans of central government to develop the industry, with major investment in recent years. However, in terms of market share the industry is still well behind the two leaders in Japan and South Korea. Chinese builders focus in particular on tankers and bulk carriers to gain volume but participate in most market sectors apart from the LNG market. China expects to achieve the capability to build LNG carriers in the near future. It is also only recently that China has developed the capability to build large tankers (aframax and above) and the construction of a greater share of the VLCC market is an aim of the industry. A greater share of the container sector, in particular the large ship sector, is also a goal of the industry. To date container ship construction has been restricted to smaller ships only.

6.3 EU

The EU industry has seen order intake fall significantly in recent years, in particular due to a downturn in the ordering of cruise ships and loss of share of the container market. Market share in the EU industry is now down to 7%. EU shipyards have lost almost all share of the bulk carrier sector and most of the tanker sector. Container ship market share, the last volume sector in which EU yards have a foothold, has also fallen over the past five years. Increasing reliance has been placed on the passenger and specialised sectors, with shipyards taking a 54% share of ferry orders in 2002 and almost all cruise ship orders. Having said this, order volume for passenger ships was relatively low in 2002 and order intake into EU shipyards was correspondingly low.

In effect the industry in the EU has had to retrench into a small number of market niches in recent years, predominantly small ships, passenger ships and specialised ships. The cruise market maintained some volume up to 2001 but with a sharp fall in order intake in that sector the industry as a whole has seen order intake and market share plummet.

6.4 Japan

Japan has seen a steady order intake in recent years, with the market lead alternating with South Korea according to shifts in market and economic conditions. Japan had a very strong market lead in 2002. Japanese shipbuilding's main product is bulk carriers for the home market, making up almost 40% of all orders taken in 2002. Oil and chemical tankers and gas carriers also make up a significant portion of the industry's business. Japanese shipbuilding has lost a considerable share of the container ship market to South Korea.

6.5 South Korea

South Korea experienced a significant peak of order intake in 2000 and a relatively steady level in other years. South Korean shipyards took over 50% of the container ship market in 2002, over 40% of the oil tanker market and significant shares of the gas and chemical tanker markets. The industry has tried to exit the bulk carrier sector because of low value, although it has been forced to take orders recently to maintain production volume.

South Korean builders have been trying to pursue a strategy to address the higher value sectors to maximise profitability, in particular the market for LNG carriers. The scope to do this is limited in relation to the volume of work needed to keep the industry in South Korea busy. The product focus tables included in appendix 3 to this report indicate that whilst there was a significant intake of LNG carriers in 2001, ordinarily this sector makes up less than 10% of the total order intake into South Korea. Korean builders have yet to penetrate the passenger ship sector to any significant degree, this being the other high added value sector that the yards may try to pursue. In a typical year up to around 80% of orders will be from the main bulk cargo sectors, tankers, bulk carriers and container ships.

7 OWNERSHIP AND CONTRACTING

7.1 Ship ownership and nationality

The ownership and nationality of a ship are complex issues. The key terms normally encountered are discussed as follows, although it should be noted that terminology varies and the definitions given may be open to debate.

- **Registered owner:** the registered owners of all ships are listed in Lloyd's Register. Whilst at first glance it may appear that the registered ownership may be the best guide to the owner of the ship there are a number of complications that cloud this category. Firstly, the registered owner may be a finance company providing a mortgage on the ship or a leasing company that leases the ship to an operator. Such an ownership gives no indication of the effective buyer of the ship. Secondly it is common practise that ships are purchased through limited companies specifically formed for the purpose of owning that single ship. This company may well be part of a web of companies and such companies are normally registered offshore. The registration of the company therefore is not a reliable guide to the nationality of the buyer or the effective operator of the ship.
- **Beneficial owner:** this term refers to the owner that derives benefit from the operation of the ship. The beneficial owner may be the registered owner or may operate the ship on behalf of others. Such third party operations may be in the form of a manager of the ship on behalf of another owner or as the effective owner of a ship that is technically the property of a financial institution, such as a bank or leasing company that buys the ship on the owner's behalf. Lloyd's Register now uses the term 'country of economic benefit' to designate the best country in which to count ownership, based on beneficial ownership.
- **Ship manager:** the ship's owner may not wish to operate the ship at all, in which case it may be given to a ship management company to handle the day to day operation. Major owners often operate a fleet that is made up of ships they own directly (albeit through single-purpose offshore companies), ships owned by financial institutions but for which they are beneficial owner, and ships managed on behalf of others.
- **Charterer:** ships are commonly operated on a charter basis in the shipping industry. The basis of the charter may be a contract to use part of the ship for a specific cargo, a whole ship for a specific voyage or a contract to operate the ship for a specific period. This latter arrangement is known as a 'time charter'. Under a time charter the owner or manager may operate the ship on behalf of the charterer or the charterer may seek to operate the ship himself, using his own crew and ship management facilities. In this case the charter is known as a 'bareboat charter' and the ship will appear to all intents and purposes to be owned by the charterer. This will often include having the ship re-painted to match the charterer's livery and using the charterer's own crew. In recent years there has been an increase in the number of ships purchased for specific time charters. In this case the effective owner of the ship may be regarded as the charterer rather than the registered owner.

As a consequence of this ownership structure the notion of an importing company for the goods produced by a shipyard is obscured. For example a German container ship operator may acquire a ship bought on their behalf by a group of German private investors through a single-purpose company registered in the Bahamas. The ship will be leased or chartered back to the operator. The ship would appear in the colours of the operator and be included on fleet lists under the operator's name. The ship is, to all intents and purposes German, but is officially owned in the Bahamas.

The nationality of a ship is further complicated by the necessity of having a 'flag state'. All ships have to be registered in a specific country and will be governed by the rules and regulations of that country. A ship may be registered in the country of the operator, but this is not necessarily so. It is common practise to register a ship in a country that has relatively permissive rules that do not impose a financial burden on the owner. Such registration is known as using a 'flag of convenience'. The most extensive flags are in Panama and Liberia. Whilst these two countries have very little effective fleet capacity, and are not noted amongst the leading world traders, they account for around 30% of the entire registered fleet in terms of dwt tonnage. Malta and Bahamas are also significant flags of convenience, with a number of other more minor flags in this category. Provision of services under a flag of convenience provides a useful source of invisible earnings for the country concerned by way of registration fees. (Flags of convenience are not a recent phenomenon, as is commonly assumed. Panama became the first nationality of convenience to mask the true nationality of blockade-runners in the American war of independence in the eighteenth century).

7.2 Choice of shipyard and purchasing

7.2.1 The global nature of the market

The commercial shipbuilding market is widely regarded as a global market. In other words shipowners are by and large free to purchase their ships from anywhere in the world where they can obtain the best deal. Apart from on the basis of price and delivery period there are few factors by which shipbuilders can differentiate themselves in the market place.

In choosing a builder there has traditionally been a preference for ordering in home shipyards where this option is available. In addition to being a cultural preference this choice makes the contracting and supervision processes significantly easier. Ordering from a shipyard across the other side of the world has long been routine in shipbuilding, however, and, as such, if a domestic purchase is not economic or feasible the procedures for purchasing at a distance are reliable and well established.

Despite the global nature of the market some sectors may be regarded as effectively closed by some shipbuilders. A good example is the Japanese domestic market whereby the majority of Japanese ships are built in home shipyards. Whilst this sector appears closed to many exporters there are many examples of ships being imported into Japan where a better deal can be obtained abroad and the market is not in reality closed at all. The preference stems from the availability of a competitive local source of supply and the advantages to Japanese owners in dealing in their own language and currency. It is only a preference, however, given that an economic domestic source of supply prevails.

Very few examples of truly closed markets can be found in the commercial market. The most prominent example is the 'Jones Act' fleet in the United States. Under US legislation (the 'Jones Act'), any ship that trades domestically within the United States, i.e. not visiting foreign ports during its routine business, must be built and maintained in US shipyards. Given that domestic trades may include routes from continental USA to Alaska and Hawaii, some of the ships covered by this legislation can be substantial ocean-going tonnage. Other examples of markets closed by the Jones Act include fishing vessels, ferries and casino and other pleasure vessels that ply in and out of a home port without making any foreign calls.

7.2.2 Choice of shipyard

The choice of shipyard eventually comes down to a small number of factors. If an owner is a regular builder he is likely to have established relationships with shipyards for building ships. For less regular builders the choice of yard is likely to be guided by the reputation of a yard for building a specific ship type and possibly the availability of an established standard ship. Larger owners may require to have a significant say in the design of the ship to suit their specific requirements, whilst many owners, in particular those buying for speculative purposes, are likely to chose established standards.

Owners may choose to use the services of a broker to assist in the choice of yard, and to guide their purchase. It would be normal for offers to be solicited from several shipyards from which a final choice will be made. The choice may include consideration of the efficiency of design, in particular the cargo carrying capacity of the ship, speed and fuel consumption. A poor design is unlikely to find a buyer but by and large most major credible yards are likely to offer an acceptable design. The final choice will normally be made on the basis of price and delivery terms.

Because most major yards will offer an acceptable design for the ships in their product mix, shipbuilders have difficulty in differentiating themselves from competitors on the basis of design. Similarly it is difficult for shipyards to differentiate themselves on quality of build. The quality of building of the ship in any shipyard is assured by the use of classification societies such as Lloyd's Register (UK), Germanischer Lloyd (Germany), Det Norske Veritas (Norway), NKK (Japan), American Bureau of Shipping (USA) and so on. The classification society will approve the details of the design and inspect and report on the building process, ensuring that it meets minimum standards. A classification certificate is essential for the operation of a ship and a contract for a new ship will include the specification of the classification standard to which the ship will be designed and constructed.

In choosing a shipyard the standard of facilities and sophistication of the shipbuilding process will figure little specifically on the shipbuilders list of priorities. In this respect the perceptions of the shipbuilder and the ship owner may differ. The owner is predominantly interested in the price and in knowing that his ship is likely to be delivered on time. To the owner the processes used to build the ship are of little consequence, except insofar as they may be reflected in a shorter build period or a lower price.

7.2.3 The contract

Having selected the preferred bidder the owner will sign a 'letter of intent to build' and will proceed to negotiate the contract, either directly with the yard or through a broker. Central to the negotiation will be price, payment terms, guarantees, delivery date, penalty clauses, the details of the specification and options. These are discussed below.

- **Price:** this is a key factor. Whilst the price will have been specified in the original offer this will now be negotiated against the details of the contract. Depending on the state of the market the power in the negotiation may lie in either direction, although in recent years because of the degree of over-capacity power has been largely in the hands of the buyer.
- **Payment terms:** it is normal for payments to be made in stages by the owner during the construction of the ship to assist with working capital finance in the shipyard. Typical stages against which payments are made include signature of contract, start of

production, laying of the keel, launch and completion. The balance of these payments will have a significant cost implication for the owner and the shipyard and the implications of this will be taken into account in the final price. The traditional payment basis was five payments of 20% spread over the contract period but this has largely been superseded in recent years by payment terms that are advantageous to the buyer, used as an incentive to attract business by the shipyard. 'Tail end' schemes, with as much as 70% of the payment delayed until delivery, have become common in recent years.

- **Guarantees:** the owner will require a guarantee for return of down payments in the case of default by the builder. Such guarantees must be acceptable to the owner's financiers. A shipyard that is unable to provide such guarantees, for example because of a poor credit rating, is unlikely to be able to sell ships.
- **Delivery date:** the owner's aim is likely to be to obtain delivery as fast as possible, but this has to be balanced against the shipyard's existing orderbook commitments. Delivery is likely to be one to two years following the signature of the contract in the present market climate.
- **Penalty clauses:** the contract will include penalty clauses to cover the eventualities that the shipyard may not perform in delivering the ship on time or that the ship does not perform to the specified operational capabilities. Both situations will have serious financial implications for the buyer and will be covered by financial penalties for the builder.
- **Specification:** the shipyard may offer a standard design at the price originally offered. The owner may subsequently seek to change details of the design or to add extra features. The shipyard will charge such changes as extras. The builder may also offer a standard list of makers of major equipment, such as engines, pumps, electronic equipment and so on, that the owner may seek to substitute his own preferred makers. Again this will have an implication on the price.
- **Options:** the owner may seek to reserve additional slots in the builder's programme to add further ships under the contract at a later date, normally at the same price. These reservations will be held for a limited time period only, after which time the slots will be offered to others.

The degree of power in each side of the negotiation will depend to some degree on the nature of the buyer. Blue chip shipping companies with extensive fleets are likely to be regular buyers of ships and as such wield a greater level of influence than one-off or occasional speculative buyers. Major shipping companies are also more likely to have their own technical departments with their own views on the detail of design and the makers list. The power balance also depends on the state of the market and the backlog at the shipyard. Clearly, a shipyard with a full orderbook is likely to negotiate harder than one in need of work.

Having placed the order the buyer will make provisions for the supervision of the construction of the ship. The owner is entitled to have representation on site during the building period to monitor activity and ensure that the work is to standard. This role is in addition to the supervision by the classification society. Many owners have their own staff on site to undertake this role, acting directly on their behalf. For smaller owners the work may be subcontracted to the classification society or surveyors contracted for the purpose. In addition to inspections by the owner and the classification society, the flag state authority under whose jurisdiction the ship is to be registered will also seek to inspect the ship, in particular with relation to safety features.

Finally, having taken delivery of the ship the shipyard will provide a warranty covering workmanship, equipment and materials, normally lasting for one year. During that year the shipyard will rectify all defects at their own cost at the convenience of the owner.

7.2.4 Financing the order

In addition to negotiating for the construction of the ship, the owner will also have to negotiate a finance package to support the purchase. Newbuilding finance is a highly complex and specialised field. The financial package behind the purchase is likely to consist of a number of instruments, typical examples including the following.

- **Shipowner's funds:** the buyer is likely to have to include some of his own capital as part of the deal to satisfy the requirements of lenders. In exceptional circumstances the purchase may be made using 100% owner's capital.
- **Bank finance:** there are a number of banks that specialise in newbuilding finance. Often this is raised through syndicates of banks, rather than individual banks, to spread the risk. Regular buyers are likely to have established links to preferred banks with which they have a good credit record.
- **Financial markets:** in some circumstances funding may be raised through the financial markets using instruments such as rights issues. Such mechanisms are normally used when the ship has the prospect of guaranteed employment such as through long-term charters. In some cases investment by private individuals may be possible through syndicates formed specifically to provide funding for ship purchase. Such syndicates may be encouraged by favourable tax regimes for shipping investment, as has been the case in the past in Germany and Norway and more recently in South Korea.
- **Leasing:** the operator may in some circumstances lease the ship back from a leasing company that will finance and purchase the vessel on his behalf.

8 PRICE

8.1 Price overview

The level of price in shipbuilding varies over time as illustrated in the following chart that presents an index of average prices in commercial shipbuilding set to 100 in 1987, the lowest point of the market in recent decades.

It should be kept in mind when reviewing this graph that the price level refers to the price at the time of ordering and not at the time of production. Prices now, for example, will dictate profitability in one to two years time, not in the year that the order was taken.

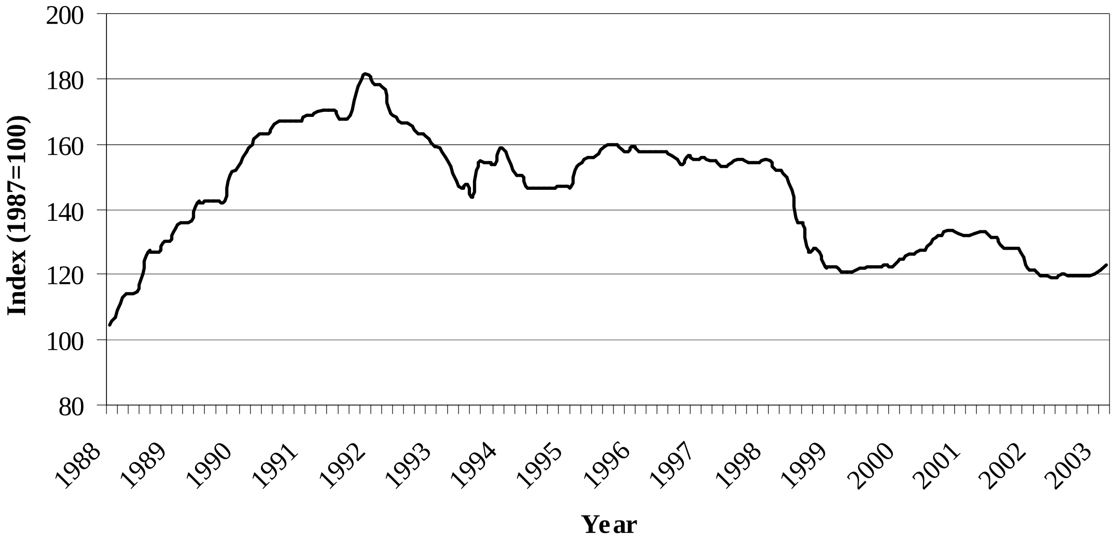

Figure 8.1 – FMI newbuilding price index

The traditional view of shipbuilding prices was that they behaved much like a commodity, with prices rising and falling along with demand. It can be demonstrated that this relationship held true in the period between 1987 and 1991, with demand and prices rising together as had been expected. The relationship between price and demand broke down in 1992, however. Prices began to fall even though output was rising strongly (see figure 5.1). Price remained fairly level at an index level of around 150 between 1993 and 1998 but then fell precipitously in 1998 to a level of around 120. Prices rose to some degree in 2001 but have now fallen back again to around the 120 level.

The fundamental change in the early 1990s that led to the de-coupling of price and volume was the expansion of capacity, as discussed in section 5 of this report.

In effect, new and latent capacity was directed at the long-forecast upturn in demand and there was never enough work to go around. Whilst it is difficult to demonstrate conclusively, because of the impracticality of accurately measuring capacity, what effectively happened over the 1990s was that development of new capacity out-stripped the development of the market and there was little opportunity for a rise in prices. The philosophy in larger yards, in particular in South Korea, was to try to improve profitability through the reduction of costs by increasing capacity and pursuing economies of scale. Unfortunately almost all South Korean shipyards pursued the same strategy and as such the solution only increased the problem.

The fall in prices in 1998 can be linked directly to the Far East Economic Crisis and, in particular, the collapse of the Won. This is discussed in detail in section 8.5 below. Since 1999 there have been attempts to raise prices in the face of rising costs and prices did, in fact, rise in 2001. The improvement was short-lived, however, and prices have subsequently fallen back to the 1999 level. Prices in all sectors have fallen. For a detailed analysis by ship type the reader is referred to the OECD report "Recent Newbuilding Price Developments", 03 March 2003, C/WP6/SG(2003)4.

The economic mechanisms that govern price are still under investigation. What has become clear, however, is that the global nature of the market means that prices are linked to some degree, even between ship types. A good example is the case of large container ship prices and the effect that this has had on the industry in Europe. Low Far East prices for large container ships have meant that market share has declined in those European shipyards seeking to compete in this sector. With less work in building large container ships the European shipyards participating in that market have to seek other market sectors to win work. This is most likely to be in competition with other European shipbuilders and the competitive pressure within Europe has therefore increased. The low price of large container ships, therefore, may have a depressing effect on the prices of smaller container ships or even completely diverse ship types such as ferries; a market competed strongly by European shipyards.

8.2 Determination of price

Ultimately the price of a ship is determined quite simply by the level at which a shipyard is prepared to take a contract and the level the customer is prepared to pay. Having said this, the determination of price in shipbuilding is far from straightforward and is subject to a wide range of influences. These are illustrated in the diagram presented in figure 8.2 and described below.

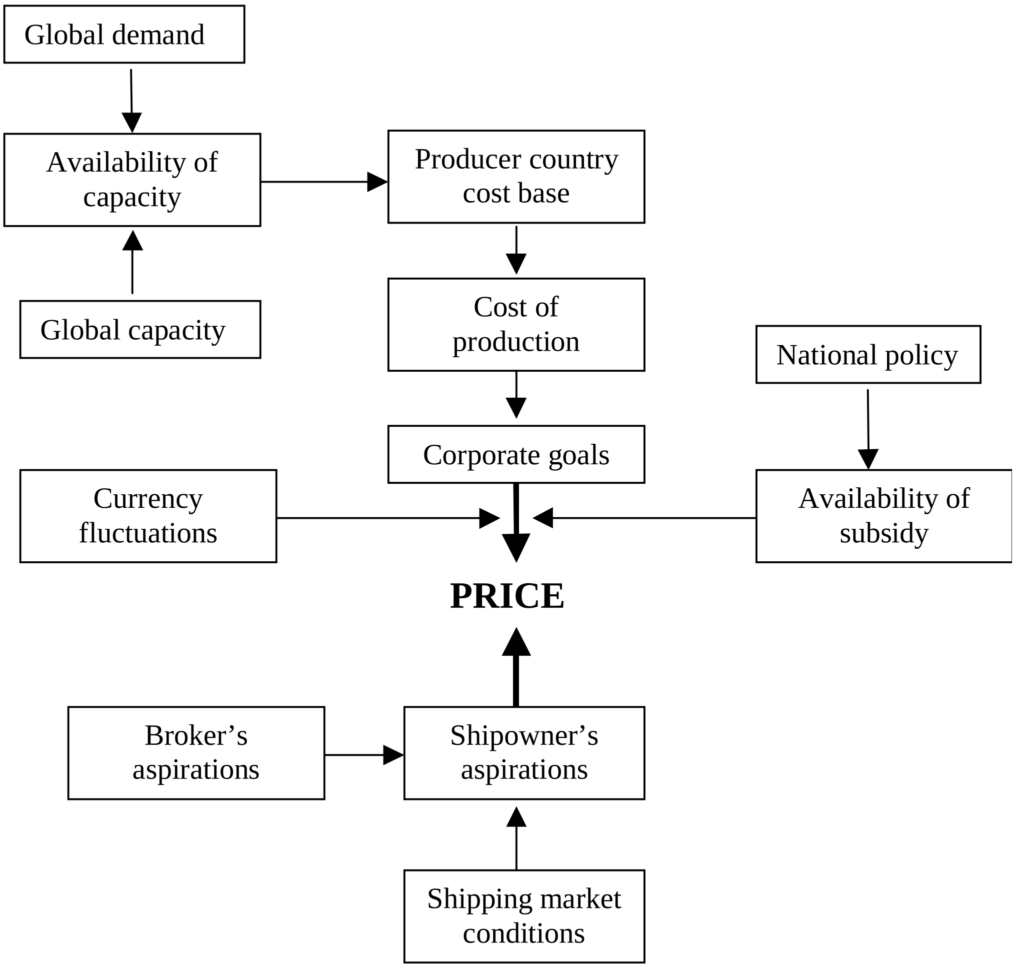

Figure 8.2 – Elements of price determination in shipbuilding

- **Balance between demand and capacity:** as discussed in section 5 of this report the traditional view of shipbuilding prices has been that they are determined by a commodity mechanism, with prices rising and falling along with demand. Detailed research, outside the scope of this report, has shown that whilst the relationship between price and volume in the long term has broken down, it remains important within specific time periods. Over a number of periods in the past decade volume has risen but price has fallen, contrary to the basic commodity view. This can be explained by the fact that the balance between supply and demand does not directly determine price but influences decisions based on producer cost, as illustrated in the diagram. Rather than being **the** determining factor in relation to price, as has been traditionally assumed, this balance is in reality only **one** of the determining influences. The level of influence will depend on prevailing market and economic conditions.
- **Shipyard cost of production and corporate goals:** the total cost of production will be determined by the cost base in the country concerned, the efficiency of the shipyard, the capital cost burden of the shipyard and the goal of the management of the shipyard in terms of profit. Corporate goals may include, for example, loss leaders to help gain entry to a new market sector. They may also include suppression of profit for strategic reasons, although it is assumed that the goal of most companies operating in the market should be to generate a return on investment.

- **National policy:** clearly the availability of subsidy will suppress the price offered by a shipyard. Direct price subsidy is only one potential means of aiding a shipyard to meet prices it could otherwise not compete with. There are numerous indirect mechanisms that have also been used. It is outside the scope of this report to present a comprehensive review of subsidies in shipbuilding.
- **Currency fluctuations:** given that ships, at least for export, are almost universally traded in $US, the fluctuation of currencies against the $ has a major effect on competitiveness and price.
- **Shipping market conditions:** the price an owner is willing to pay will be determined by his perception of future earnings. If the owner intends to operate the ship himself, the level of freight rates will determine his forward revenue. The assessment of these former earnings will dictate the level of capital cost that can be justified in purchasing a new ship. If the owner is building to sell speculatively then he will have made an assessment that the ship will be worth more in the future than the purchase will cost him, with the implications that prices are low.
- **Broker's aspirations:** the broker makes his earnings as a percentage of the price and as such his aim will be to get as good a price as possible for the ship. There is a fine balance between value per ship and volume of sales, however, and as such the broker's influence on what the shipyard is willing to sell for and what the owner is willing to spend is limited. There is strong evidence that prices quoted by brokers, including those published as price monitors, lag behind the market. Actual prices tend to be lower than brokers quotes of market level when the market is rising and tend to be higher when the market is falling.

In essence, there is no single driving force behind the determination of price in commercial shipbuilding and all of the above factors have to be taken into account.

8.3 Shipbuilding costs

The basic relationship between production costs and price are described in the following diagram and discussed in detail below.

Direct costs
+
Overhead costs
=
OPERATING COSTS
+
Interest costs
+
Depreciation
=
BREAKEVEN COST
+
Profit / Loss / Subsidy
=
PRICE

Figure 8.3 – Elements of shipbuilding costs

- **Direct costs:** the direct costs for the production of the ship include four main elements: material costs (including subcontracts), labour costs, working capital costs for the construction of the ship and other direct charges including classification fees, design costs, warranty provision and insurance.
- **Overhead costs:** the revenue from the ship must make a contribution to overhead costs. The main categories are costs of sales and marketing, general costs and administration costs (so called S,G&A categories).
- **Operating costs:** the sum of the direct costs and overhead provision gives the operating cost and the difference between this value and the price gives the operating profit. It is often the operating profit that is quoted by shipyards when discussing profit. This is not a measure of profitability of the company, however, because it doesn't include provision for below the line items, in particular the financial burden imposed by the investment in the facility. In shipbuilding this can be very high because of the high cost of developing facilities and technology.
- **Interest costs:** this category includes the cost of interest in relation to the development of the shipyard and the overall financial situation of the company, rather than working capital interest that is included in direct costs. Interest costs in shipbuilding can be substantial, because of the high cost of development of the facility and, in some cases, the high cost of financing accumulated losses.
- **Depreciation:** the contract should make a contribution to the cost of development of the facilities in which it is constructed. In the profit and loss equation this is done through depreciation. In terms of cash flow the contract should contribute by making a contribution to the debt servicing commitments of the company in cash terms. In a

shipyard, cash to repay loans has to be generated from the construction of ships and the price must include a provision to reflect this.

- **Breakeven cost:** this is the level at which profitability should be measured. In shipbuilding, when prices are low, it is often convenient for shipbuilders to price with reference to the operating cost without taking ‘below the line’ costs into account. The alternative may be not to take the contract, an outcome that is difficult to accept in shipbuilding because of the imperatives of keeping a large workforce and expensive facilities busy. This is a high risk strategy, given the high cost of operating a shipyard.
- **Profit / loss / subsidy:** if the breakeven cost is lower than the price then the shipyard will generate a profit. Alternatively the contract will make a loss. In a healthy business the occasional loss over a contract could be regarded as normal. If too many of the contracts are loss making, however, a subsidy will be required to keep the business open. Subsidy has been a common feature of the shipbuilding industry over the past thirty years, using both direct and indirect methods.

8.4 Added value

It appears axiomatic to state that the price of a ship depends on its type and size. A cruise ship, for example, is undoubtedly going to be more expensive to buy than a bulk carrier. The intuitive assumption is that a ship with greater complexity will necessarily be more expensive than a ship with lower complexity. The concentration on ships with higher complexity, coupled to the perception that higher complexity commands a better price, has been the strategy adopted by many shipbuilders in the past. Detailed analysis reveals, however, that this is not necessarily the case. Higher work content does not automatically equate to higher value of work.

To illustrate this it is necessary to examine the economics of contracts in detail, and in particular to examine the added value available for a contract against the work content of the ship. The added value inherent in a shipbuilding contract is defined as follows:

Price
-
Materials and subcontract costs
-
Contract financing costs
-
Other direct costs (see the definition above)
=
ADDED VALUE

Figure 8.4 – Definition of added value

The added value is, effectively, that portion of the revenue from the ship that is available to run the business of the shipyard, covering labour costs, overhead, interest, depreciation and profit. The other elements of the price, listed in figure 8.4 above, are paid out of the shipyard to other businesses.

To compare added value between contracts it is helpful to view it against the work content inherent in the ship, measured by the CGT value. The resulting quotient gives the added value per unit of work and is directly comparable between contracts, irrespective of the ship type. To illustrate the level of value in the market at the present time the following table lists comparative average numbers for the main ship types as recently estimated by the author from examining specific contracts.

Ship type	Estimated average added value ($US) per CGT
Bulk carrier	290
Container	500
Tanker	390
LNG carrier	680

Table 8.1 – Comparative added value per ship type

The figures in Table 8.1 are intended for illustration of the order of added value of different ship types. Absolute values will depend on actual price and the economic efficiency of the shipyard. It is clear, however, that not all contracts contain the same level of added value for each unit of work undertaken. This has to be set against the cost of developing technology and facilities for construction. It is very expensive, for example, to develop the capability to build LNG carriers. Thus whilst they carry a value about a third higher than container ships this may not necessarily cover the additional cost of development to build that ship type.

The added value is often confused with the complexity of the ship. To illustrate this, the following statistics present estimates of the movement in added value per CGT for VLCCs and LNG tankers from 1997 to 2003. Over this period the price of a VLCC has fallen from around $83 million to $69 million and that of an LNG tanker from around $230 million to $160 million.

Ship type	Estimated added value ($US) per CGT	
	1997	2003
VLCC	760	480
LNG tanker	1,570	680
Relative value of LNG tanker compared to VLCC	206%	142%

Table 8.2 – Comparison of the change in added value of VLCCs and LNG tankers

Both ship types have seen a reduction in price, but the reduction in the price of LNG tankers has been far higher. Whilst the relative complexity between the two ship types remains largely unchanged, much of the additional added value inherent in an LNG tanker has been eliminated. This is the result of heavy competition to gain a share of what is perceived as a high value sector. The development of capacity to gain market share has stripped out a good portion of the value that was being pursued.

8.5 The Far East economic crisis and the prevailing situation

As can be seen from figure 8.1 prices fell significantly over 1998. The reason for this fall can be linked directly to the Far East economic crisis prevailing at that time and, in particular, the collapse of the Won. The value of the South Korean Won plummeted, almost overnight, from a prevailing level of around 900 to the $US to around $1,700 to the $US. This is illustrated in figure 8.5, showing the development of the Won between 1997 and 2002.

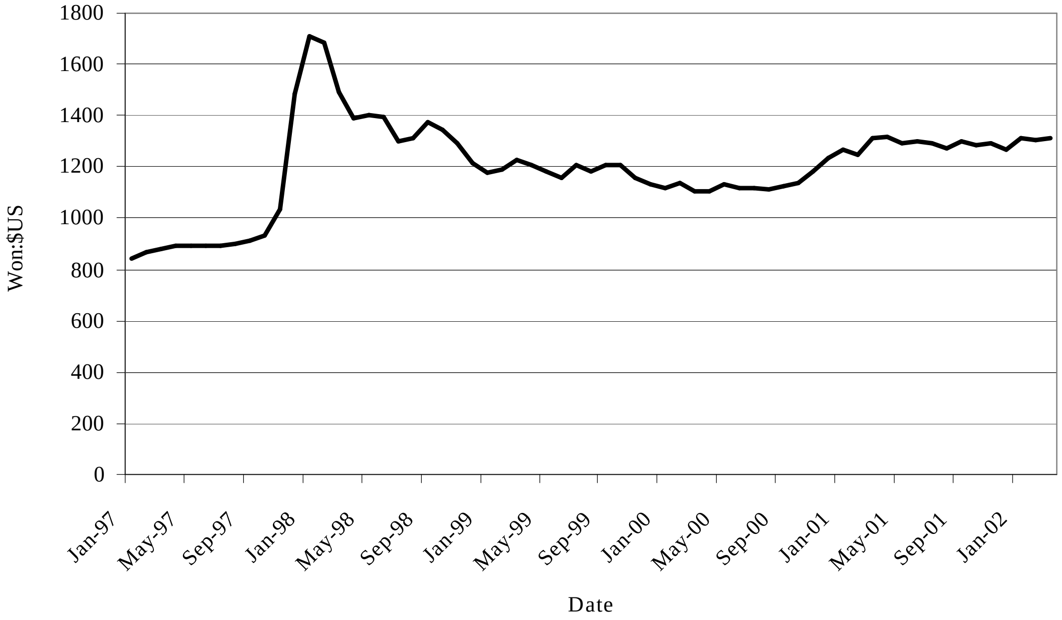

Figure 8.5 – Development of the Won against the $US

Whilst this exchange movement had an adverse effect on raw material prices it also gave an immediate boost to the export-focused shipbuilding industry, who's prices are denominated in $US. This had two immediate effects. Firstly, for contracts taken before the crisis profitability increased significantly. Given that orders are taken for delivery one to two years ahead, the production of these orders gave a boost to the profitability of Korean shipyards in 1999 and 2000. Secondly, the weakening of the currency enabled Korean shipbuilders to substantially reduce their prices and this led to the fall in price in general seen over 1998, as shown in the index in figure 8.1.

With reduced prices and increased capacity the South Korean shipbuilding industry was able to increase its market share from 25% in 1998 to 33% in 1999 and 36% in 2000. Korean capacity was filled, with other sectors of the industry around the world unable to match Korean prices. This has proved to be a double-edged sword for Korean shipyards, however. As can be seen from figure 8.5 the value of the Won rapidly recovered from the very weakest point and by mid-1999 had settled at around 1,200 to the $US. The weakening of the Won had led to raw material price increases and wage inflation continued in South Korea at between 10% and 15% per annum. Without price increases profitability in South Korean shipbuilding started to deteriorate and a number of shipyards got into financial difficulties (Daewoo, Halla and Daedong in particular).

With full orderbooks taken over 1999 and 2000 prices rose in 2001. Order intake in South Korea fell from 2.6 million CGT in 2000 to 1.7 million in 2001 and the shipyards were able to reduce the pressure on order intake to some degree. By 2002, however, orderbooks were no longer full in Korean shipyards and the industry reduced prices again back down to immediate post-crisis levels set in 1999. Given that costs have moved on significantly since 1999 further deterioration in profitability is now anticipated.

Significant amounts of research have been undertaken on behalf of the EU to evaluate the relationship between costs and prices in South Korean shipbuilding. At a high level this work can be summarised by the chart presented in figure 8.6 below. This chart presents indices of price and cost set to 100 in 1997. The price index is based on the overall price index presented in figure 8.1. The cost index takes into account the following movements:

- Change in labour cost due to wage increases/decreases.
- Decrease in labour expenditure due to productivity improvement.
- Change in material costs.
- The split between domestic and imported materials.
- Development of the exchange rate with the $US.

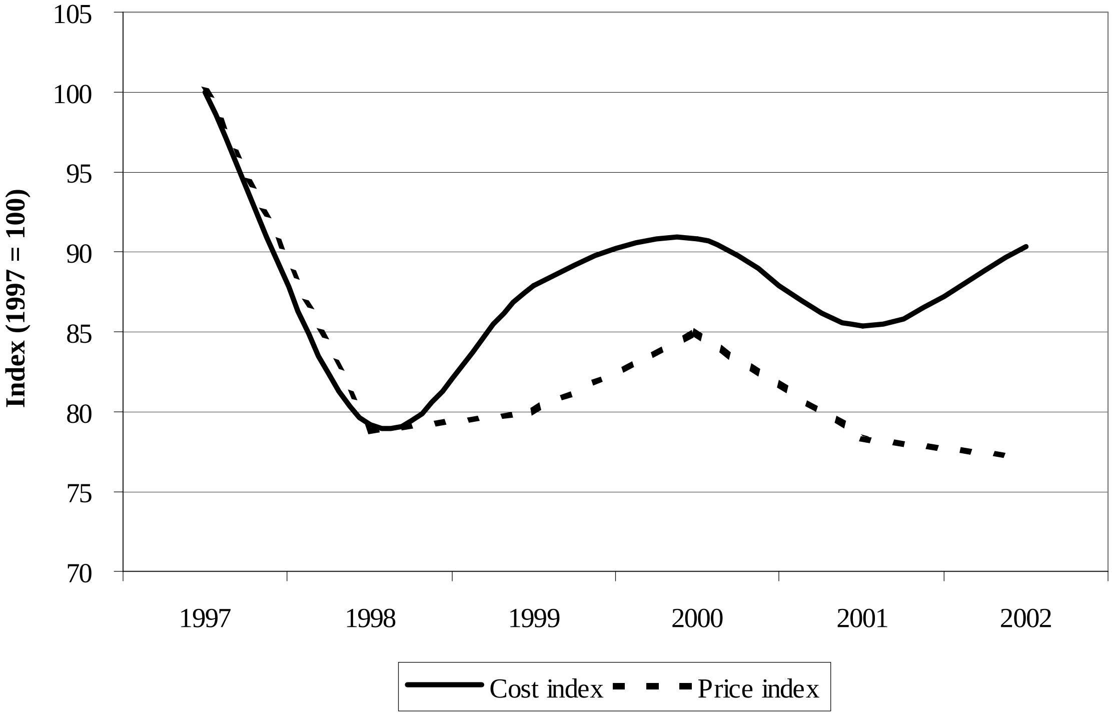

Figure 8.6 – Movements in costs and prices in South Korean shipbuilding

It can be seen from figure 8.6 that over 1997 and 1998 the two indices followed each other well. A gap opened up in 1999, however, as costs rose but prices remained level. This gap remained fairly constant in 1999, 2000 and 2001, as prices rose and the exchange rate moved in South Korea's favour. In 2002, however, the gap widened as the exchange rate strengthened again and prices fell. In 2002 it was estimated that the gap between costs and prices, compared to the situation in 1997, had reached 13% and was widening further as costs increase but prices remain low.

APPENDICES